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Railways, City Transit, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewerage and Municipal, Electrical, Contracting, Proposals Open, Manufacturing and Technical.

SAFE METHODS OF CAR HEATING will be positively required in Maine after the close of this season. The law passed in that state in 1889 provided that any method of car heating must be approved by the Rail road Commission before use, and that "in no event shall a common stove be allowed in any passenger, mail or baggage car." Under this law, the Commission followed the example set by the Massachusetts and New Hampshire Commissions, and approved various methods of heating by independent heaters. In a circular just issued, the Commission says that under this law they have approved of systems of heating but little safer than the common stove, and that after June 30, 1892, "no method of heating cars will be approved which, in the opinion of the Board, will not reduce the danger by fire to passengers and employees to a minimum."

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS is meditating two new departures of some importance; the one being a convention at San Francisco next spring, a special train for the round trip being hired for a month at a total cost for all traveling expenses of $300 per member, and the other a considerable increase of the dues, the entrance fees being made $25 instead of $15 for members and associates, and $15 instead of $10 for juniors, and the yearly dues being raised $5, making them $15 and $10, instead of $10 and $5. As a partial return for this increase, however, the yearly transactions will be delivered to members bound instead of unbound.

THE MEXICO MAIN DRAINAGE TUNNEL is now being advanced at the rate of 600 lin. ft. per month and the canal approach thereto, at the rate of 300,000 cu. yds. per month. These rates will be increased in the near future and it is considered that in 30 months at the furthest, the waters of Lake Texcoco will be drained off, thus freeing the city from the danger of inundation which continuously threatens it, and at times overwhelms it. In the mean time extensive local drainage works within the city are shortly to be undertaken.

THE TRUNK LINE PASSENGER TRAFFIC (first and second class) has been partitioned by Commissioner GODDARD as follows: New York Central, 33⅓; Pennsylvania Railroad, 25; Erie, 15; Baltimore & Ohio, 9½; West Shore, 6; Lackawanna, 5½; Ontario & Western, 3, and Lehigh Valley, 3%. The immigrant traffic out of New York is divided equally among the several roads. In this new arrangement the first and second class passenger traffic is evened up by the immigrant traffic. The New York Central road, for instance, is likely to do a great deal more first and second class passenger business than its allotted percentage. Its passenger business to Chicago in recent years has stood as follows:

	1st class through to Chicago.	1st and 2d class to and beyond Chicago.
1887	41.63%	34.14%
1888	42.87%	35.80%
1889	44.58%	38.39%
1890 (strike)	37.10%	32.73%
1891 (3 mos.)	46.58%	38.57%

THE GREAT LAKES are for the present growing lower every year. According to the report of Gen. O. M. POE, U. S. Engrs., the level of Lake Huron was in June, when the water is highest:

1886	583.13 ft.	above the sea.			
1887	582.38	"	"	"	"
1888	581.79	"	"	"	"
1889	581.04	"	"	"	"
1890	581.01	"	"	"	"
1891	580.40	"	"	"	"

The Sault Canal now shows a depth of 14 ft. 4 ins. only. There is very naturally a good deal of alarm among shipowners at this progressive diminution, but it appears to be due only to the fact that the rainfall also has been below the normal, and in all probability will shortly cease.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a derailment, Oct. 14, at Hicksville, Ind., on the Baltimore & Ohio R. R. The train consisted of the engine and tender, baggage car, smoking car, sleeping car, ladies' car and the private car of Vice-President KING. The whole train left the track, and the sleeper, ladies' car and the private car went over an embankment. The smoker and baggage car were not detached from the engine. Two passengers were killed, three were seriously injured, and several were slightly injured, Mr. KING being among the latter. On Oct. 9 while an eastbound freight train on the New York, Lake Erie & Western R. R. was running between Ridgewood Junction and Ridgewood, one of the cars jumped the track, and fouled the westbound track, when it was run into by a work train. The engine of the work train was wrecked, and the fireman killed. A crossing accident occurred on the Long Island R. R. at Flushing, N. Y., last week. An electric car was crossing the tracks just after an engine and one freight car had passed, when it was run into by a number of cars which had broken loose from the front part of the train. The electric car was wrecked, and 2 passengers seriously injured. The gateman claims that the engine driver did not give the signal whistle indicating "train broken," until he had passed the crossing.

A BROKEN PISTON-ROD interrupted the eastward trip of the Sound steamer *Connecticut* of the Providence line on Oct. 12, fortunately without damage to the vessel or her passengers. The *Connecticut* is a paddlewheel steamer equipped with a peculiar type of oscillating compound engine with inclined cylinders. Members of the American Society of Mechanical Engineers who were on that steamer last summer in going to or from the Providence Convention will remember the engine and the comments made on the bending strains which are thrown on the piston rods in oscillating the heavy low-pressure cylinder.

A HIGHWAY BRIDGE, near Lima, O., gave way, Oct. 4, under a heavy threshing machine. Two men were killed.

A NEW DRY DOCK FOR THE NAVY-YARD at Brooklyn, N. Y., is proposed by the Navy Department. The sum of $500,000 is to be applied to this purpose, and the dock will be a timber dock similar to the one last built. The present demand upon the two docks now in use is much more than they can meet. The engineer of the yard, Mr. ASSERSON, recommends that it be located next to the new timber dock, where there is 26 ft. of water, and where the pumping plant now in use can be made to serve both docks at a comparatively slight cost for connections. The probable length of the dock will be 600 ft.

THE CANADIAN SOCIETY OF CIVIL ENGINEERS now has a membership of 640, against 588 a year ago, viz.: 281 members, 105 associate members, 75 associates and 172 students; 16 members, 2 associate members, 13 associates and 20 students were added to its rolls during the past year. The dues of students are only $2 per year, of members, $8 and $10.

STEEL TIES, made by the Standard Metal Tie & Construction Co., of New York, were placed in the track of the Chicago & Western Indiana Railway in October, 1889. Mr. JOHN W. CLARKE, Roadmaster, who placed them in the track, now makes a report upon them, of which the following is an abstract: He finds that the total expense on 1,000 lin. ft. of track laid with the Standard steel tie, during 19 months was $45.50. The greatest part of this was expended in the first surfacing up in soft ballast to bring the steel ties to the same elevation as the wooden ties alongside. During the same 19 months the cost of labor alone on the 1,000 ft. of track alongside laid with wooden ties was $210.25. This was equal to a saving in labor alone sufficient to purchase 65 new steel ties. The track was exposed to a very heavy traffic, but Mr. CLARKE says that the part laid with the Standard tie was "not only safe, smooth and pleasant to ride upon, but the ties were a money-saving device, and should commend themselves to railroad men from that standpoint." He adds that by reason of the rail being held rigidly upright, the life of the rail was increased a good many per cent. He also observed that there was less oscillation and vibration in the engines and cars passing over them, especially in heavily loaded cars of yielding material like grain. He believes that rolling stock would also have a longer life for these reasons. A description of the Standard tie, with a report from Mr. CLARKE, was given in ENGINEERING NEWS, Feb. 7, 1891.

THE CRAMP SHIPBUILDING CO., in Philadelphia, has commenced work on its new yard, which will have a frontage of 1,200 ft. on the Delaware River and be 3,000 ft. deep. The largest dry-dock in America is to be built here, made in two sections so as to be capable of docking two vessels at once. There will be also seven landing ways, each large enough to admit of the simultaneous building of ships-of-war of the *Philadelphia* or *Chicago* type. Twenty-five acres have been devoted to the erection of the machine and erecting shops, boiler-houses, &c. The area of this new yard in the lower part of the city will be eight times larger than the present yard of the company, from which so many good ships have been launched.

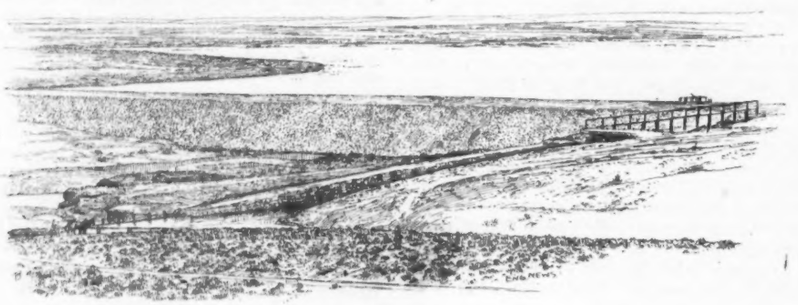
THE AMERICAN STEEL BARGE CO., of Buffalo, N. Y., has increased its stock capital from $2,000,000 to $4,000,000. This company builds the "whale-back" barges, and Capt. MCDOUGALL says that his company will shortly be at work on eight new vessels, six of them to be steamers. The yard can now turn out a barge complete in 60 days, and will shortly do this in 30 days. Work is to be shortly commenced on a passenger ship, 450 ft. long, to run between Duluth and Buffalo. The yard will turn out this winter 16 steamers and barges of an aggregate tonnage of 50,000 tons.

THE PHILADELPHIA CAR SERVICE ASSOCIATION, Mr. J. E. CHALLENGER, manager, has for its business the speedy discharge of freight cars. The report for the first year of its existence, ending Aug. 31, 1891, shows that the company has handled 802,920 cars in that time. Each of these cars was detained an average of 1.44 days, as compared with an average of 3½ to 4 days, the usual delay prior to the advent of this company. To handle each car costs an average of 4⅗ cts., and it is expected to reduce this to 2½ to 3 cts. for the next year. For lumber and coal the average detention was less than 1½ days. The gross operating expenses amounted to $34,798 for the year. The net collections from charges to the consignees for failing to unload freight within the time prescribed by the association amounted to a little more than the expenses named. The purpose of the association is not revenue, but "to keep the wheels moving" in the interest of owners.

Pecos Valley Canals.

BY HERBERT M. WILSON, M. AM. SOC. C. E.

The Pecos River rises in the northern part of New Mexico, northeast of Santa Fé, and flows in a southerly direction to the neighborhood of Fort Sumner, N. M., after which its course is a little to the east of south across the territorial line into Texas, in which state it finally joins the Rio Grande. It is a mountain stream subject to alternate flood and drought until it reaches the neighborhood of Roswell, N. M., whence for a distance in a straight line of about 100 miles in a due southerly direction its course is so tortuous that the length of the river is probably 250 miles. This portion of the river is fed by numerous springs which generally enter it along its bed following the limestone strata of the country. These springs represent the drainage from the eastern slopes of the Capitan, Sierra Blanca, Sacramento and Guadaloupe mountains, and the water of the upper river which disappears below Fort Sumner. The rainfall in the Lower Pecos Valley is from 12 to 15 ins. per annum, though it is much greater than this higher up the valley and somewhat less as the river enters Texas. Likewise as the valley diminishes in altitude from the high mountains at the head of the river near Santa Fé to the level lands in Texas the temperature varies from that of a northern temperate zone country to one having nearly a semi-tropic climate. That portion of the valley in which the great irrigation canals are situated is subject, however, to frosts, so that while it is well suited to grape culture, citrus fruits cannot be raised with any surety. In this portion of the valley while the summers are very warm the winters are not cold; some snow falls every winter in the neighborhood of Roswell, but further south it rapidly disappears. The rain occurs mainly in June, July and August in the form of showers and is extremely variable and uncertain.



Main Dam and Reservoir. Pecos Irrigation & Improvement Co.

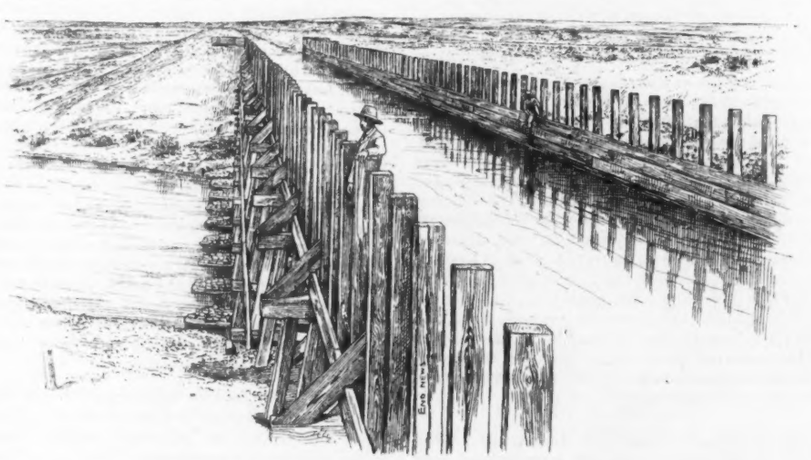
The lands of the Pecos Valley between Roswell, N. M., and Pecos, Tex., which latter town is 30 miles south of the territorial line, are broad and level, and are probably the best agricultural lands in the State. They are of the choicest limestone soil, and their total area is nearly 1,000,000 acres, of which fully 400,000 acres are below the level at which it is practicable to deliver water from the Pecos. In their natural condition these lands are for the most part covered only with a scant growth of Gramma grass, while in the lower portion of the valley, especially below the town of Eddy, the land is covered chiefly with greasewood, the roots of which are not in the way of the plow, and by mesquite, the value of the roots of which for kindling wood fully compensates for the expense of grubbing. In order to irrigate these lands the surface requires no leveling for the distribution of water, the natural slopes toward the river to the south being just sufficient to afford every facility to make the practical work of irrigation comparatively inexpensive.

The lands of the Pecos River may be divided into three principal sections or divisions. The first extends from the mountain region northeast of Santa Fé to Fort Sumner, and is a country the altitude of which is too great to be well suited to agriculture, though it furnishes some of the best grass lands for cattle raising to be found anywhere. The second extends from Roswell, which is on the Hondo River, to Seven Rivers, and broadens out into a plain containing thousands of acres of fine agricultural land. On the east side of the river it is a country of springs and marshes in the midst of wide and fertile plains. These powerful springs, which occur at short distances across the plains from east to west below Roswell, form deep streams with rapid currents, which are from 30 to 60 ft. wide and constitute the Hondo River, a branch of the Pecos. This is the water supply of the upper canal system which is here entirely independent of the Pecos. The third section of the river extends from the cañon eight miles above Eddy, to some distance below Pecos City, Tex. This portion of the valley of the Pecos is from 25 to 30 miles in width and contains the richest agricultural region in the Pecos Valley; it is a plain covered with a soil of fine dark loam from 16 to 20 ft. deep, between the cañon and the Black River, which is 30 miles south of the cañon. The country has a steeper slope than lower down and the soil is lighter and of a more pliable and sandy character.

To irrigate the second and third sections of the Pecos Valley, companies have been organized within the past few years and have constructed four separate canal systems, which are, however, owned by only two companies. The more important of these, the Pecos Irrigation & Improvement Co., has built three dams, at which head the three most important canal systems in New Mexico. The northern canal consists of a dam across the Hondo River below the junction of the North Spring and Berenda rivers, five miles east of Roswell, whence a canal runs southeasterly and southerly to where it crosses the South Spring River, at which point a pick-up weir is built which turns the water southward through a main canal to the Feliz River, a distance of 25 miles, bringing under cultivation 60,000 acres of fine agricultural land. This canal is now being extended to a length of 50 miles, and with the construction of proper storage reservoirs may be extended so as to irrigate 100,000 acres more of equally productive land reaching down to Seven Rivers in Eddy County. The middle dam of this company is built across the Pecos River below the cañon about 6 miles north of Eddy, and from it a main canal runs along the east bank for a distance of 4 miles to a bifurcation, whence the principal branch crosses the river on a flume and extends down the west side of the valley for a total length of 55 miles, terminating at the Delaware River and bringing under irrigation at least 150,000 acres of rich alluvial soil. On the Texas line the eastern branch extends for a distance of 20 miles down the east side of the valley, terminating in a dry lake and bringing under irrigation 50,000 acres of rich, sandy loam. A part of this same system is a short branch called the Hagerman Canal, heading on the east side of the river 15 miles below Eddy and having on its line a large storage reservoir, which is about 1½ miles long and ½ mile wide, with an average depth of 25 ft. The third or southern canal system of this company is now being constructed, the water to fill it being diverted from the Pecos River by the construction of a large dam in Texas just south of the territorial line. This canal, when completed, will be 25 miles long and will irrigate about 70,000 acres of land in the State of Texas.

The other principal canal system in the third section of the Pecos Valley is owned by the Pioneer Co., in Reeves County, Tex., and consists of a much smaller canal than those owned by the Pecos Irrigation & Improvement Co. This canal heads about 10 miles north of Pecos City and flows along the east bank of the river for a few miles, after which it is bifurcated, one branch running down the east bank and the other across the river on a flume to the west bank, whence it continues down that side of the river to 3 miles below Pecos City. Though this canal is comparatively small it brings under cultivation some excellent soil. It is well constructed, the works on its line in particular being substantially built.

The principal canal and that which is of most interest to the engineer from its construction and magnitude is the Middle canal of the Pecos Irrigation & Improvement Co., that which heads below the cañon a few miles above the town of Eddy. This canal is diverted from the river by means of a great dam built of loose rock and earth, which is 1,600 ft. in length on its crest and 50 ft. in maximum height. This dam follows a gap or notch worn through a solid limestone ridge and hence its abutments and foundation are of solid rock. In addition to acting as a diversion weir this dam forms a great storage reservoir about 7 miles in length and 1¾ miles wide, the capacity of which is claimed to be 23,000 acre-ft., though but a small portion of this can be used for supplying the canal, as the sills of the headgates of the latter are but 20 ft. below the high water mark in the canal and thus but that depth of water is available. In plan the dam is shaped like the letter L with the re-enterent angle pointing up stream and the long arm abutting against the canal head. The long arm which composes the main dam is 1,070 ft. in length and varies from 5 to 50 ft. in height. The short arm is constructed wholly of earth and is 530 ft. in length with an average height of about 2 ft. At the end of the dam farthest from the canal is an ample waste-way, 256 ft. wide, and excavated in the limestone rock to such a depth that its bed is about 5 ft. below the



Terre-Plein and Flume Across Pecos River.

crest of the dam. This waste-way is 300 ft. long and has a grade of 1 in 3. For greater security and certainty of action it should be deepened somewhat. In the rock cut in which the canal heads is an additional waste-way, just below the end of the dam and above the regulating gates. This escape has a total length of 206 ft. and is about 2 ft. deeper than the first mentioned. It is accordingly brought first into action and between the two the dam may be considered perfectly safe from floods or cloud bursts.

The main dam is composed of a prism of loose rock 12 ft. wide on top, 100 ft. wide at bottom, with lower or outer slope of 1½ to 1 and inner slope ¼ to 1; its maximum height is 50 ft. The up stream face of this loose rock dam is of earth, 10 ft. wide on top, 200 ft. wide on bottom, and with an up stream slope of 3½ to 1, which is faced with 18 ins. of riprapping to prevent wave action. The lower portion, or toe, of this earth slope is replaced by 10 ft. in depth of loose rock to prevent undercutting. This dam was carefully and substantially built, all the rock being

The West Side Canal.

hand placed, while the earth was well tramped over with scrapers. The canal heads at the east end of the dam in a rock cut 30 ft. wide, 25 ft. deep and 500 ft. in length, which has a waste-way for the discharge of the superfluous waters of the reservoir at its entrance, and an escape-way at the lower end of the cut and below the regulating head in the canal, which latter is placed in the cut. In the bottom of the dam, near the end adjacent to the canal head, is an under sluice the sill of which is 37 ft. below the dam crest. This sluice is 4×8 ft. in the clear; its grade is 1.2 ft. in 100 ft., and its discharging capacity with the reservoir full is about 2,000 second-ft. The lining of the culvert or under sluice is of rubble in cement, and is 8 ft. in thickness. The regulating gates in the rock cut at the canal head are 6 in number, each 5 ft. wide by 9 ft. high. These are operated by a male screw of steel attached to each gate, on which a female screw made of malleable iron is turned from above. The gates are of wood, 6 ins. in thickness, and slide between wooden posts each 12 × 12 ins. The discharge capacity of the entire regulator is 3,000 second-ft. The main canal below the rock cut is 45 ft. wide at the bottom, 70 ft wide on top, has side slopes of 1½ to 1 and will carry a depth of 6 ft. of water. Its grade is 16 ins. per mile and its capacity about 1,100 second-ft. It is excavated thoughout in a light sandy loam. The first portion of this main canal is four miles in length to the bifurcation and both in this and in the lower portion of its line the embankment is thrown up wholly on the lower side wherever the canal is in side hill excavation, so that the floods cause by arroyas entering the upper side become fair sized ponds or reservoirs, in which the waters of the canal spread out. Were water more valuable at present this would be a decided disadvantage, as the loss from seepage and evaporation is very great in such places. Still, as the water supply in the river is yet abundant during the flood season of the year, these places serve as storage reservoirs and thus add materially to the summer discharge of the canal.

At its entrance to the canal the water is controlled by means of two sets of regulating gates, the main set at the head of the rock cut consists of six gates built of wood in a most substantial manner and abutting in the rock. These gates are operated by means of powerful screws from above. At the lower end of the rock cut and at the head of the canal proper is another set of gates, four in number, which cannot be lowered when the cut is full of water, but can be dropped in case of necessity. Adjacent to these are a set of 10 escape gates, each 7 ft. wide, giving a clear escape-way back into the river, having a width of 70 ft. At the point of bifurcation four miles below the canal head, are two sets of regulating gates, that at the head of the Eastern canal, containing 6 openings, and the one at the head of the Western canal 7 openings, each 15 ft. in the clear, while between the two is an escape gate consisting of 5 openings each 5 ft. in the clear, which discharges the water through a short channel back into the Pecos River below the flume.

From the bifurcation the canal crosses the low valley of the Pecos River and that stream itself, by means of a high terre-plein or raised earthwork embankment and a great wooden flume. The first terre-plein, that leading to the river, is 1,000 ft. long and 105 ft. wide at the base, and has a maximum height of 24 ft. The terre-plein on the west bank of the river is 300 ft. long, and is likewise 24 ft. in maximum height. Between the two is a flume the length of which is 475 ft., its width is 25 ft. and it carries a depth of 8 ft. of water. Below the crossing of the Pecos the West side canal has a bed width of 25 ft., slopes of 1½ to 1, carries a depth of 6 ft. of water and has a uniform fall of 18 ins. to the mile. This canal, a view of which is shown, passes about 1½ miles west of Eddy and follows along the main portion of the valley for 8 to 10 miles back from the river and is at present completed as far as Black River, across which a high flume is about to be constructed. In addition to the main canals connected with this system there are at present constructed over 100 miles of laterals each from 4 to 6 ft. wide and carrying a depth of from 1 to 2 ft. of water, while several hundred additional miles of these laterals are to be built in the immediate future.

The lands through which this canal system run are principally government lands, the company having no ownership in them. Much of this land has already been entered by settlers since the construction of the canal. The main storage and diversion dam cost $90,000, the remainder of the works about $400,000, in addition to which $800,000 is invested in a railway 90 miles long and other improvements for the development of the property of the company. The capital of the company is $1,300,000, while its contracts for water rights payable in cash and 8% mortgage notes due within 6 years, cover about one-third of the total cost. A perpetual water right can at present be purchased from the company at $10 an acre, payable in 10 annual installments in addition to which the annual water rental is $1.25 per acre. These prices are very low, but will doubtless be advanced as the country is better settled.

The Use of Magnetic Concentrates in the Port Henry Blast-Furnaces.*

It is now about two years since we began using concentrates from Port Henry magnetic ores in the blast furnaces of Witherbee, Sherman & Co. During this time we have had the usual ups and downs incident to blast furnace practice, and have used the concentrates in various proportions with our new bed (Bessemer), old bed (high-phosphorus) and mill ores, making both Bessemer and mill-iron.

In the early part of 1889, owing to frequent changes in the experimental concentrating plant, the supply was not regular, causing intermissions in which no concentrates were charged. The tabular statement given below shows the days run, the proportions and kinds of concentrated and other ores used, etc. It may be as well to say that all our ores are magnetic.

The new bed ore is mostly granular or shotty; the run of mine is usually a lump ore containing more or less of fine. Old bed is about half lump and half fine; and of the mill ore, three-fourths or seven-eighths is as fine as buckshot, the rest being lump. All lumps are hand broken to about 3 ins.

We began using new bed concentrate in our No. 2 furnace, running on mill iron, commencing with $\frac{1}{4}$, which was continued for nine days without showing any bad effects, when it was increased to $\frac{1}{3}$, and this proportion was continued with two short intermissions for 56 days. The mixture was then changed to Bessemer, and the proportion of concentrate was $\frac{1}{5}$ for 29 days, when it was increased to $\frac{1}{6}$ for 15 days, then reduced to $\frac{1}{5}$ for 80 days. During this time we had also used $\frac{1}{5}$ concentrate in our Cedar Point furnace, running on Bessemer iron, for 56 days.

Up to this time we had not used a larger proportion of the concentrate than $\frac{1}{5}$, but had used it with various proportions of our other ores in making both Bessemer and mill iron without any more troublesome experience than usual in the working of the furnaces, and also without any advantage, so far as could be observed, except that due to increased yield from the richer concentrate replacing "run of mine" and mill-ores. There had been no decrease in fuel consumption that could be attributed to the use of concentrate except what was due to the increased yield of the mixture. Pressure and general working of the furnaces was about as usual. Our fuel is ¾ Delaware & Hudson lump coal and ¼ Reynoldsville or similar coke.

In March last, the new concentrating plant at the mines having been completed, it was decided to concentrate old bed ore, running about 63% iron and 1.25% phosphorus, and at the same time to try the experiment of increasing the proportion of concentrate in No. 2 furnace, then running on mill iron, with the view of determining the maximum amount that could be used, and to note the effect of its substitution for other ores.

We commenced with $\frac{1}{5}$ concentrate and ran for 9 days without noticing any effect either way, then increased to $\frac{1}{6}$ for 12 days. During the 12 days' run, the concentrate was of 16 mesh size, and carried 67% of iron. All the previous concentrate had been of 10 mesh and 60% to 63% iron. When the $\frac{1}{6}$ came through, a change was noticed at once; the furnace began to get hotter and the burden was increased. After the 12 days' run the concentrate was made 10-mesh in size, and increased to $\frac{1}{5}$ for eight days and then $\frac{1}{6}$ for 14 days, when all concentrate was taken off.

With each increase of concentrate the furnace got hotter, necessitating increase of burden. It worked very smoothly and regularly, but with 1 to 1½ lbs. higher pressure with the larger amount of concentrate. During the latter part of the run, and from the time the charge of $\frac{1}{6}$ concentrate began to work, the average fuel per ton of iron was 18% lower than it had been for several weeks preceding or was immediately after. Of this reduction in fuel, about 5½% was due to the increased yield of iron in the mixture.

It is but fair to say, however, that the iron made was less open (about one grade lower) than before the experiment. Just at this time we received an order for a low silicon iron for immediate shipment; and as the tendency of this mixture, when making an open iron, was toward high silicon, the burden was kept rather heavier than it otherwise would have been, which, of course, made the grade lower and the reduction in fuel somewhat more marked.

After running a short time on mill iron without concentrate, the furnace was changed to Bessemer, using new bed concentrate, 10-mesh, 67% iron, as follows: $\frac{1}{5}$, 10 days; $\frac{1}{6}$, 4 days; $\frac{1}{5}$, 14 days, and $\frac{1}{6}$, 11 days; total, 39 days. During this time the furnace worked smoothly and regularly, with about the same increase of pressure and reduction of fuel as when using the old bed concentrate.

In conclusion, our experience seems to have demonstrated that with proper management there is no difficulty in using in the blast furnace at least 30% of high-

* A paper by N. M. Langdon, Port Henry, N. Y., read at the Glen Summit meeting of the American Institute of Mining Engineers.

grade concentrate, and that there is also, especially in the use of a large percentage of concentrate, an economy of fuel beyond that which may be due to an increase of iron in the mixture. This increased economy may be attributed to the comminution of the ore.

TABLE OF MIXTURES.

New bed.				Old bed.			
Days run.	Concentrate.	Run of mine.	Pure.	Concentrate.	Run of mine.	Mill ore.	Iron made.
9	1-14	3-14	....	....	4-14	6-14	
5	2-14	2-14	....	....	4-14	6-14	Mill.
51	2-14	2-11	....	....	5-14	5-14	
29	2-10	2-10	6-10	....	....	....	
15	3-10	5-10	2-10	....	....	....	Besse-
7	2-10	6-10	2-10	....	....	....	mer.
73	2-10	8-10	....	....	....	....	
9	....	3-10	....	2-10	2-10	5-10	
12	....	3-10	....	4-10	2-10	1-10	Mill.
8	....	3-10	....	5-10	2-10	....	
14	....	2-10	....	6-10	2-10	....	
10	4-10	2-10	2-10	....	....	....	
4	6-10	2-10	4-10	....	....	....	Besse-
14	8-10	2-10	....	....	....	....	mer.
11	7-10	3-10	....	....	....	....	

The Reports of the New York City Rapid Transit Commission Engineers.

We gave last week the reports of Messrs. WM. E. WORTHEN, W. B PARSONS, OCTAVE CHANUTE and JNO. BOGART on the proposed rapid transit railway for New York City. The following are the reports of the other two consulting engineers whose opinion was asked by the Commission:

REPORT OF THEODORE COOPER, *Consulting Engineer*,

I am not able to give my approval of the plan of either Messrs. WORTHEN or PARSONS in its entirety. I agree with Mr. WORTHEN that a two track road will be ample below City Hall. The capacity of two tracks to handle the traffic below City Hall will be far greater than four tracks at points above City Hall. All trains will doubtless run as locals below City Hall. The great difficulties of construction in this section increase the desirability of restricting the tracks to the minimum number. For a two-track road the vaults will not be encroached upon except for station purposes, and the opposition of vault owners will be avoided. I do not approve bringing the iron cover of the tunnels into direct contact with the material of the street above, more or less saturated with corroding liquids leaking through from the street surface; nor do I believe it possible to properly protect such iron surfaces from corrosion by the injection of any kind of metal preservative.

The pole system of tunneling proposed by Mr. WORTHEN for driving his tunnels beneath the existing system of pipes, etc., without disturbance to the sand above or the street pavements does not meet my approval, both on account of the impossibility of protecting the iron covering from corrosion and also as involving undesirable risks.

I think very favorably of Mr. PARSONS' double-deck system for certain portions of the road, but do not approve of the center pipe gallery, nor the admission of the sewer pipes within the track tunnel. If a pipe gallery be considered desirable, it should be, as far as practicable, entirely independent of the railway system. All gas should be carried in a special conduit near the surface of the street, where it could be freely ventilated without connection with any other conduits or tunnels, to avoid the formation of an explosive compound due to the leakage of gas. The sewer pipes shown on Mr. PARSONS' plan adjacent to the express tracks occupy space needed for track repairs, and are objectionable from possible leakage and fouling of the tunnels.

Neither plan makes suitable provision for crossovers or side tracks. Mr. PARSONS' central gallery cuts off all communication between the up and down tracks, and Mr. WORTHEN'S arrangement of 4 tracks on a level does not permit ready interchange between the outer tracks. It is essential to any system of rapid transit to have at suitable intervals crossovers between the up and down lines, and also at least one middle standing track at important stations. Without such adjuncts to the system, the traffic becomes completely blocked by a disabled train, broken track, or other accident at any point of the line.

Mr. PARSONS' method for constructing the tunnels has the merit of finally disposing of all the pipes, etc., and making Broadway a completed street, free from future excavations. It also provides a satisfactory method of protecting the iron covering of his tunnel by a layer of concrete, etc.

Neither of the plans submitted provides sufficient room for track repair and maintenance and safety of necessary trackmen Occasional places of refuge for the men will not be sufficient. There must be sufficient room at all points for the workmen and their tools. If the safety of these men is doubtful, it will be impossible to keep the system in that perfect condition necessary for safe operation of trains. Four feet clear of the car body is the least that in my opinion should be allowed for the safety of the workmen.

The vertical depth of the cars proposed has been reduced by the selection of a low form of truck and cutting off a portion of the monitor roof of the car. Such departure should only be made after the most careful investigation. The main objection to the low truck is the increased difficulty of access for inspection and repair, a matter of great importance upon a system which will be worked to its maximum capacity. The monitor roof is essential for the proper ventilation of the cars.

Mr. COOPER then points out the changes which he would make in the plans proposed by the Commission's engineers as follows:

From the Postoffice to the Battery I would provide a double track line with a loop at the Battery, and provision there for additional tracks. Stations on this section to be between tracks and below all pipes and conduits, pipes to be removed to one side of the street. Above the Postoffice, along and under the City Hall Park, I would insert one or more central standing tracks, with crossovers connecting them to the up and down tracks. By these, trains can be either run around the loop at the Battery or dispatched directly from the City Hall station. At the upper end of City Hall yard the two main tracks would branch into four tracks, and the two inner of these would be gradually dropped down and the two outer drawn together, until they could be brought into double deck form; this type of construction would continue until it becomes necessary to flatten them out into four tracks upon one level to pass below Canal St. with minimum depth. Then they are again brought into the double deck form and continued thus to near Twelfth St. At this point the four tracks again spread out to one level and drop gradually down until they pass completely into the rock, with sufficient rock roof to protect the street system above.

At Union Square, the junction between the west and east side lines can be made without any grade crossings by dropping one set of tracks beneath the other set. Above Union Square the four tracks of the west side lines continue, still in the rock, up Broadway to some point near Forty-sixth St. From this point north the tracks can be brought close to the surface. At the viaducts near 125th St. and above the cemetery of Trinity Church, the tracks should be brought close together, but upon one level. At the Harlem Ship Canal, it would be well to keep at an elevation which would give passages below for shipping equal to the openings at High Bridge, thus obviating the necessity of a drawbridge in the system.

Methods of Construction.—From the Battery to near Twelfth St., the best means of constructing the tunnel through the subsoil of sand with the least interference with business and property interests and also in the most rapid and economical manner is by the use of some modification of the Beach shield. It would perhaps be necessary to use in connection with it either the open cut method or some special method of tunneling at the stations, crossovers and junctions.

From Fourteenth St., north, the rock comes near the surface. The surface of the rock over the upper part of the route is irregular. In many places it was higher, and in other places lower than the present street grades. The depressions have been filled with broken rock, earth, sand and stones. To construct tunnels close to the present street grades, through such materials, along an important thoroughfare, with its underlying system of pipes, conduits and sewers, would be difficult, tedious and expensive, by either the open cut method or any system of tunneling. By dropping the line down, as proposed, so that it would be entirely in rock, the problem of construction over such portion of the line would be rendered comparatively very simple. By careful working, a roof of 6 to 8 ft. would be enough to protect the streets and pipe system from injury. The level of the station platforms would then be from 25 to 40 ft. below the street grades. Above Forty-sixth St., where wider streets, less traffic and fewer street pipes are found, it would be well to bring the tunnel near the surface. The character of the rock along the whole route will undoubtedly compel the lining of the tunnel with masonry.

While it may be best to use some other cross section than a circle, a circular section of about 16 ft. diameter for each track would give plenty of room for cars of the same type as are used upon the elevated railways, and still leave room for the safety of track and patrol men, by placing the track on one side of the central line.

REPORT OF JOS. H. WILSON, *Consulting Engineer*.

The lines of road appear to have been located with good judgment, and are capable of future extension by branch lines. Other things being equal, the design adopted should be that which offers best facilities for connections with branch lines. These connections should be made without grade crossings, which requirement would necessitate a greater lowering of the track in the double deck system than in the four track level system, since the pipe gallery in the former which has to be passed extends about 3 ft. 3 ins. below the upper deck track, and may be made even deeper in the future. This excess of depth in the double deck system necessary to avoid grade crossings is between 8½ and 9 ft.

I would criticise Mr. WORTHEN'S plan for a branch at Union Square, as it has two grade crossings; and suggest that the tracks be arranged with over and under crossings.

No matter what the type of construction, the loop system seems to be the only feasible arrangement for a successful rapid operation of the line at the southern terminal. The considerable depth of the tracks below the tidewater level would render the use of the four-track level system advisable here and at Canal street in any event.

I think that two tracks, as proposed by Mr. WORTHEN, will be sufficient for the traffic on that portion of the line below City Hall, taking into consideration also the increased difficulties of construction on this part of the line.

Mr. WORTHEN'S plan of placing the track beneath the sidewalk on lower Broadway is a good one; but unless there are obstructions with which I am not familiar, it would be preferable to place the tracks not together, but one under each sidewalk. Should it prove to the advantage of an underground road to make use of a portion or all of the side pavement vaults, reserving 5 ft. in the upper part for light areas, the question of giving consideration to a partial obstruction of these vaults does not appear to me to be a very important one.

More or less underpinning and strengthening of foundation walls, will in any case be needed. A list of the buildings on Broadway with the depths of foundations shows many cases in which there are no vaults under the side pavements, and a large number of buildings whose walls will require under any circumstances more or less underpinning. I have had myself some of this very difficult work done, where walls 50 ft. in height have been underpinned with 7 to 8 ft. of foundations, and have afterwards been increased to 100 ft. in height without showing any visible crack or settlement. But such an operation is one requiring great care, with more or less risk, and it is expensive. In this respect the four-track level system has a great advantage over the double deck system, as its foundations are not so deep by about 5 ft.

As to dealing with the pipe and wire systems now under the streets, it would appear to me inexpedient that a rapid transit railway company should be burdened with the expense of providing a pipe gallery and a rearrangement of all the pipes and wires in such gallery, if it can be avoided. Admitting all its advantages, I do not think that the cost of such work should be placed upon the railway company.

Now the four-track level system does not go to so great a depth by about 5 ft. as the double deck system, and does not disturb the present pipe systems. At the same time it allows of the construction of pipe galleries over it whenever in the future it may be demanded, without requiring any depression of the rail level below what is given in the present plan. These galleries may be only on each side of the center, leaving the larger water mains undisturbed; or they may extend the whole width of the railways with a clear height of, say, 5½ ft. to 6 ft., and would be quite ample for all possible wants. They would, moreover, afford every facility for cross-street house connections, which, while arranged for in the case of the double deck system, are not, in my opinion, entirely satisfactory or properly accessible for repairs or additions. The lowering of a pipe, or the undue exposure of a workman, might be the cause of a serious accident. The railway company should have exclusive control of its right of way, and be put beyond the chances of any interference, such as this arrangement might cause.

For those parts of the line above Forty-second St., the Commission has shown proper judgment in deciding on a four-track level system, and Mr. WORTHEN'S plans appear to meet the general requirements very well, although I should not favor the building of viaducts for three tracks.

Ten feet clearance in height for the tunnel is sufficient. Cars can be designed 8 ft. 6 ins. in width, and of height to pass with this clearance that will meet all requirements. Ridge ventilation of cars will not be required; and the system of ventilation suggested by Mr. WORTHEN of taking air in front of the train while in motion can by proper control be very effectually carried out. The cars should be of steel, the windows fixed.

Means must be provided for protecting track inspectors and workmen in the tunnel from passing trains. In the four-track-level system, a space about 4 ft. in the clear should be allowed between cars on the center tracks, and men standing there when trains pass can cling to the columns. Refuge niches should be built in the side walls, say every 10 to 12 ft. They should be from 2 to 2½ ft. in depth, say 4 ft. wide, and sufficiently high for a man to stand, having also a little iron hand rail. An incandescent light could be placed over each niche, showing at once its location. These niches can be built in the regulation thickness of the walls, without materially adding to its expense. The double deck system provides a footwalk 2 ft. in width next to the side wall as a passageway, but this would not be safe in a tunnel without refuge niches

I see nothing in the structural details of either the double deck or the four-track level system that is not capable of being actually constructed. In fixing an assumed load as a basis for calculations, account has very properly been taken of the risks to which the structure might be exposed from the impact of heavy loads, and perhaps of falling walls, in case of fire to adjacent buildings, etc. On the Boulevard and upper sections of the line, these conditions do not apply as they do in the narrower streets and

built up parts of the city, so that for these portions the load might be modified, resulting in some saving of cost.

The great mass of earth over the tunnel in the four-track level system will very considerably modify and reduce the effect of impact from live loads. But the dead load to be carrried is so much greater in this case that the assumed total load should be about the same. Mr. WORTHEN assumed 2,000 lbs. per sq. ft. for his loading. With this assumption 15 in. beams are not heavy enough for 22-ft. spans. They should be 20 ins., or an intermediate column should be introduced, preferably the latter.

In the four-track level system the depth of platform floor is greater than your prescribed limit of 20 ft., beyond which elevators are to be used.

Elevators will be necessary with the double deck system to reach the platforms for express trains. Thus the double deck system favors the local traffic at the expense of the express, while the four-track level system accomodates all alike, and gives better facilities for transferring passengers between local and express trains.

Station stairways should have steps not over 6 ins. rise by 12 or 14 in. treads. Station platforms should not be under 15 ft. in width. The minimum clearance between the stairways and columns and the trainways should be at least 3 ft., and as much more as possible. Over the platforms frequent pavement lights should be introduced, the walls should be lined with glazed tiles and every effort should be made to give brightness and cheerfulness to the general effect.

In the four-track level system it would be best to deflect the local tracks at all stations and adopt "Island" platforms; thus local stations can be changed at will to express stations, and either track can be used for all service at night, when the number of trains is reduced, or in case of accident or repairs blocking one track. At stations which are only local, express tracks can be separated by a division rail, rapidly removable when desired. Local trains must stop at all stations and for safety an absolute block system will, of course, be used, with signals at every station.

Ventilation.—The adoption of electric motors simplifies this question. Reliance on the piston principle is not, in my opinion, either an essential or effective method of ventilation. I would leave the whole tunnel open, using exhaust fans placed midway between stations, ventilating cars by regulated admission of air at front; ample openings should be arranged at stations for fresh air to enter the tunnel.

The construction of a tunnel under Broadway by any method will be a difficult operation. The question of interference with the use of the streets is one of the first importance; and in adopting a method of construction, this matter should receive a very prominent consideration. Of the two schemes, the four-track level system offers very considerably less obstruction to traffic in the streets than the double-deck system. Omitting the stations, the only work to be done on the surface is the building of the longitudinal side walls, and these will create no disturbance, except for a narrow width on or close to the sidewalks. After these are put in the surface can be restored to its ordinary condition, and need not be disturbed again.

Mr. WORTHEN's plan for longitudinal excavation under the streets is feasible and practicable. There may be certain points, as at Canal St., where open excavation must be resorted to; but these will be very few. I do not see how the double-deck system or any structure which comes close to the surface of the streets can be built without very largely disturbing the street traffic. If laid below the street pipes, it would involve going to so great a depth that the difficulties would be largely increased.

Any system of construction worked from the street is liable to very considerable interruption and damage from surface water accumulating in times of storm. This would not occur in underground work, and so long as the grade is kept above tide I believe the tunnel will be free from water.

In any system of construction near the surface, the care of gas and water pipes and their rearrangement in a pipe gallery would be a much more serious question, in my mind, than might at first be supposed. The work of excavating and building must be prosecuted among those pipes, which may be met with at most unexpected places, often interfering with the proper placing of beams or columns; the pipes must be temporarily supported by timbering for long distances and for a very considerable length of time before new pipes are placed and put into use; and in every way the risks are very great. A sudden rain flood may come, washing out or settling temporary supports and causing in consequence, breakage, leakage and untold damage.

In Mr. WORTHEN's system of construction the permanent work follows the excavation so closely and the excavation is carried on in such a manner that risk of settlement and breaking or leakage of pipes is reduced to a minimum.

I think that Mr. WORTHEN's proposed method of excavating transversely from the curb line will require more study before it can be practically applied. The manner of proceeding, as described by Mr. WORTHEN for this mode of working, is not so clear to my mind as in the case of the longitudinal method, and I think that more timbering and temporary shoring will be needed than he appears to contemplate, although the execution of the work is practicable and can be accomplished. I should favor the employment of the longitudinal method as much as possible, and would only make a transverse excavation just sufficient to start the longitudinal shields.

In conclusion, I favor the four-track level system, essentially as submitted by Mr. WORTHEN, modified as I have suggested, as it favors better facilities for connection with branch lines, interferes less with foundations, does not disturb pipe and wire subway stations at present in existence, but permits them to be readjusted and placed in galleries in the future if desired without interference with the railway system, gives better facilities for transfer of passengers at stations, is capable of being better ventilated, and affords better facilities of construction with much less obstruction of street traffic.

The Worthen Plan of Constructing the New York Rapid Transit Railway Under Lower Broadway.

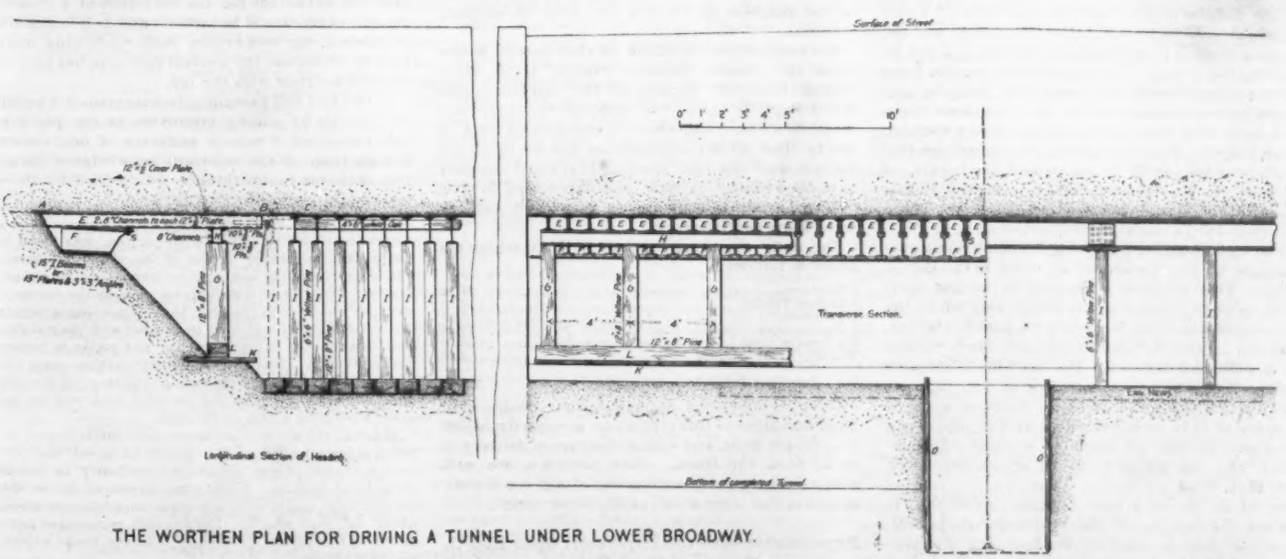
As stated last week, one of the most important engineering questions reported on by the Rapid Transit Commission's consulting engineers is the feasibility of the scheme recommended by Chief Engineer WM. E. WORTHEN for driving a four-track tunnel of rectangular cross-section through the sand which underlies Broadway below Fourteenth St. the roof being at a depth of 8 ft. below the surface. This system is approved as safe and feasible by two of the consulting engineers, Messrs. JOS. M. WILSON and JOHN BOGART, while it is rejected as unsafe by the other two, Messrs. THEODORE COOPER and OCTAVE CHANUTE.

Through the courtesy of Mr. WORTHEN we are enabled to reproduce herewith a drawing showing the proposed method of construction, which at the request of Mr. WORTHEN, was worked out in detail by Mr. L. L. BUCK, M. Am. Soc. C. E. The following is Mr. BUCK's report to Mr. WORTHEN describing the designs submitted:

"The design is intended for a case in which there are two parallel walls already built, which are to form the sides of the tunnel. The roof of the tunnel is to be composed of iron beams extending across the tunnel and covered by plates. The plates extend across the tunnel, and have such a width as to extend from the center of one beam to the center of the next one. The ends of the beams are to rest on the walls, and they are to be supported at the center by a longitudinal row of iron columns.

Description of Apparatus.—The pieces marked *E, E, E*, etc., are each composed of two parallel channels set on edge and covered by a 12-in. × ¼ in. plate riveted to the upper flanges of the two channels. The upper side and each edge of the plates and the lower sides of the channels are to be planed. These pieces, *E, E, E*, etc., are to be placed side by side close together and lengthwise of the tunnel. The piece *F* is designed to support and guide the forward ends of *E, E, E*, etc. It consists of a broad steel or iron plate, lying nearly horizontal, extending in one or two pieces nearly across the tunnel, and having riveted to it at intervals of 12 ins. upright partitions made of 15-in I-beams or of plates and angles, so as to be in the planes of the channels of *E*. The rear end of the upper flange of each partition is provided with a set screw for the purpose of adjusting the inclination of *F*. The rear ends of the pieces *E, E, E*, etc., are supported by posts, *G*, which rest upon a sill, *L*, and are capped by a box girder, *H*, on which *E* rests. The pressure of the sill is distributed on the earth by horizontal longitudinal planks laid close together. The pieces *H* and *L* extend nearly across the tunnel.

Method of Proceeding with Excavation.—The pieces *E E E*, etc., are each driven longitudinally forward into the earth, closely followed by the piece *F*. As they are forced forward the material included in their cells is dug out. The face of the heading below *F* is kept with a sufficient slope to form a support for *F* at all times. As often as all of the *E* pieces have been moved forward 13 in., first *K* and then *H, G* and *L* will be driven forward a like distance. Preceding each movement of the apparatus, one roof beam and plate will be put in place under the projecting ends of the cover plates of *E*, these cover plates projecting to the rear beyond the channels sufficiently to always lap a few inches on to the next to the last roof plate put into position. The apparatus will then be driven forward sufficiently to admit of the insertion of another roof beam and plate.



THE WORTHEN PLAN FOR DRIVING A TUNNEL UNDER LOWER BROADWAY.

The inclination of *F* will depend upon the nature of the material encountered. It should be just sufficient to compensate for the compression of the bank on which it rests and thus keep the pieces *E, E, E*, etc. at the proper level. If the rear supports of *E, E, E*, etc. are found to be settling too much, it can be remedied by keeping the points of the planks driven farther forward of the sill *L*, when they will tend upward enough to compensate for

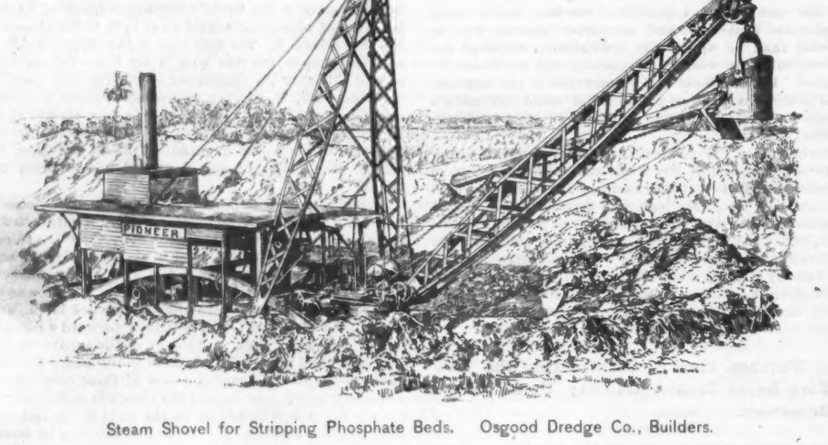
compression. The pieces *E, F, H, G* and *L* can be driven forward either by jacks or rams. The planks *K* can be driven by mauls.

If the roofing beams were continuous over the middle supports, they would have points of contrary flexure at a certain distance each way from the middle supports. Hence, so far as the superincumbent dead load was concerned, they would be subject only to shearing force at such points, and could be cut in two at these points and the shear satisfied by web splices. If the abutting ends are squared and drawn closely together, a splice riveted to the lower flange will satisfy the requirement of any partial live load that may pass over any portion of the street above the tunnel. Hence the beam could be taken into the tunnel in three pieces and riveted together in place.

Temporary shores, *I*, will be placed so as not to obstruct the piercing of roof beams and plates, and also to admit of sinking a trench along the middle of the tunnel in which to construct the foundations of the middle row of permanent columns."

A Mammoth Steam Shovel for Stripping Phosphate Beds.

In our issues of July 11 *et seq.* we gave an account of the mining of phosphate of lime, which has become an important industry in parts of South Carolina and Florida. As there stated, the layer of phosphate nodules in the South Carolina mines is found at a depth of 5 ft. to 15 ft. below the surface, and the mining consists in stripping the surface soil and removing the nodules. This is generally done by hand labor; steam shovels have been tried, but have generally proved unsuccessful, as they could not dump the excavated material at the necessary distance from the pit. Recently special excavators for this work have been built by the Osgood Dredge Co., of Albany, N. Y., the last of which is for the Bolton Mines Co., which operates extensive phosphate mines at John's Island, near Charleston, S. C.



Steam Shovel for Stripping Phosphate Beds. Osgood Dredge Co., Builders.

The accompanying engraving is made from a photograph of the excavator at work in the Bolton mines. This machine is claimed by the manufacturers to be the largest steam shovel ever built, the increase of size being necessary to enable the machine to dig at a sufficient depth and dump its load at a sufficient distance. The machine illustrated weighs 56 tons and runs on a track of 7 ft. gage. It will dig to a depth of 10 ft. below the track and to a distance of 45 ft. on either side, and the dipper can be swung through two-thirds of a circle. The material may be dumped 30 ft. above the track and 40 ft. from its center. The machine moves forward 15 ft. at a time. How much this is beyond the capacity of the steam shovels in ordinary use may be seen by the fact that the largest standard size of steam shovel built by the Osgood Dredge Co. digs only 5 ft. below the track on which it moves and 26 ft. to either side, and dumps 32 ft. above the track and 24 ft. from the center. The weight of this machine is 40 tons, while the weight of the phosphate excavator is 56 tons.

The general arrangement of the machine illustrated in our engraving is similar to that of the standard steam shovel of the Osgood Co. The machine is mounted on a car 40 ft. long and 13 ft. wide, built with arched side trusses. The trucks have 33-in. wheels with 5¼-in. steel axles and two babbitted bearings to each wheel. To enable the machine to be turned at the end of the cut without loss of time, a truck is placed under the center of the car carrying a ring of coned rollers on which the machine may be turned end for end in its own length. This is especially necessary in phosphate digging, where the machine has to traverse back and forth across the fields until the whole surface has been dug over.

The dipper has a capacity of 1¾ cu. yds. when even full, and in ordinary working about two dippers full per minute can be handled. Power for working is supplied by a reversible double cylinder engine with two friction drums and cylinders 10 × 12 ins., and a "crowding engine" with double cylinders 6 × 8 ins. These are furnished with steam by a locomotive boiler 54 ins. diameter and 14 ft. long.

The boom and A-frame are made of iron with cast-steel hinges for raising or lowering; the stay-rods are of Burden's best iron 1¾ ins. diameter with a spring in the boom stay to avoid shocks; the jack screws are 4½ ins. diameter, of hammered steel, with brass nuts 13 ins. long. The nominal capacity of the machine is 150 yds. per hour in ordinary material.

The manufacturers inform us that recent letters from the Bolton company express much satisfaction with the working of the machine. One dated Sept. 9 says: "In spite of the very wet weather we have had since it commenced work, it has fulfilled all our expectations and we think it a success and the best machine that could possibly have been built." A later one dated Sept. 26 says: "The excavator is showing up very nicely and the work is very satisfactory."

The daily operating expenses of this machine are about as follows:

1 Engineer	$4.00
1 Dipper Tender	2.50
1 Fireman	2.00
8 Tracklayers	12.00
1½ Tons of Coal	6.00
Water, Oil, Waste, etc	2.00
Total per day	$28.50

The manufacturers announce their readiness to build machines of this type up to a capacity of 300 cu. yds. per hour, and with a distance of delivery of 50 ft. from the track. Such machines are well adapted for stripping surface deposits of ore or coal, or excavating large drainage ditches or canals.

Experiments with the Imperatori Open-Hearth Process of Steel Making.

The Imperatori process of steel-making, described in the following paper, presented at the Cleveland meeting of the American Institute of Mining Engineers, by Mr. J. B. NAU, is a modification of the open hearth process. We understand that it has met with considerable favor abroad, and though of recent introduction has been put into regular use. One interesting feature of the process is that it promises to utilize to great advantage the rich concentrates of iron which are produced by magnetic separation.

The Imperatori process is a sort of mixed process in which a large amount of rich ore can be treated in presence of a metallic bath. The reasons that seem to have guided the inventor in his researches are the following: It is well known that the ordinary practice in the Martin-Siemens process consists in smelting in an open hearth furnace a certain amount of pig-iron together with a larger or smaller proportion of scrap. Thus, in certain works, where scrap-iron is abundant and cheap, the proportion of pig may be as low as 10%, whereas, in other works, where the conditions for the supply of scrap are less favorable, the amount of scrap used in the charge may be more limited. The idea of substituting for a part of this sometimes very expensive scrap a corresponding quantity of rich iron ore, which can be obtained at a much lower price, is quite natural. Thus the practice of the so-called pig-and-ore process consists in adding to a bath of liquid pig a certain amount of rich iron ore, which, by its reduction, will energetically oxidize the silicon, carbon and manganese of the pig iron.

But in the ordinary ore process; as it is practiced, for instance, in England, the amount of ore to be added is limited by the following conditions:

1. The oxygen contained in the ore added must be only sufficient to oxidize the three elements aforesaid.

2. The amount of all the bases present (oxide of iron excepted) must be such that they will just suffice to neutralize the silicon in the pig iron; that is to say, form a suitable slag with the silica produced by oxidizing this silicon.

These two conditions permit an easy calculation of the amount of ore required to supply the necessary oxygen for the refining of the pig iron in the presence of a flame, which itself has a slightly oxidizing effect. Of course, the amount of ore to be added will vary according to its quality and nature.

The author then explains the method of calculation of the percentage of ore required to reduce a pig iron of any given composition in the open hearth furnace, and shows that while exact determinations are not possible, yet it has been found good practice to add about 20% of ore to the charge. Evidently the amount of ore to be added is limited by the percentage of silicon, carbon and manganese contained in the pig iron. The amount of these elements is always below certain limits in the pig iron; and the amount of ore added to the charge may only reach a certain maximum percentage determined by those limits. Every particle of ore added beyond would occasion a clear loss of iron. But for well known reasons it would not be advisable to increase silicon and manganese in the pig beyond a certain limit. Hence the only element that could be increased with practical advantage for the reduction of a greater amount of ore would be carbon; and as it is difficult to obtain a pig iron or iron bath containing more than 5% of carbon, the general endeavor has been to introduce carbon with the ore.

In 1881 and 1882 experiments were made in Sweden and Austria by adding briquettes to the pig iron bath composed of various mixtures of ore, carbon and pig iron. Some important knowledge of the action of the ore in the furnace was gained by these tests by Prof. von EHRENWERTH.

The ore, which had been supposed until then to have a direct decarbonizing action on the pig iron, was found to act, on the contrary, by means of the slag it produced. The briquettes of pig iron, ore and carbon, instead of sinking completely into the metallic bath are, on the contrary, partially dissolved in the slag, thus furnishing a highly ferruginous cinder which by its contact with the metallic bath deprives the latter of carbon and yields in return part of its iron. Hence a double reaction takes place between the iron bath and the ferruginous slag; on the one hand a refining action on the metallic bath, and on the other a reducing action on the slag.

Although the above experiments gave partially good results, at least as far as the quality of metal was concerned, the loss of iron incurred was too heavy to permit economical working. These experiments, so far as the writer knows, had been abandoned as unsatisfactory when, about one year ago, Mr. IMPERATORI, encouraged more or less by the results previously obtained, made experiments of his own.

TESTS MADE IN AMERICA.

The Imperatori process consists substantially in treating an intimate mixture of finely pulverized rich iron ore (at least 50% of iron) and carbonaceous materials, agglomerated into briquettes, in the presence of a metallic bath of pig iron or carburetted iron. The relative proportions of carbon and ore are calculated in such a manner that the carbon is present in sufficient quantities to re-

duce the ore directly to the metallic state, without previously being transformed into a carburetted product. The amount of carbon to be added to the ore to reduce it to metallic iron can easily be determined on the assumption that the carbon will be burnt half to CO and half to CO_2. The ores used in the tests at Croton magnetic mine were concentrates of magnetic ore, carrying, on an average, 64% of metallic iron, or 88.40% of magnetic oxide, containing 24.4% oxygen. As may easily be calculated, this amount of oxygen will burn 12.2 parts of carbon, half to CO and half to CO_2. The coke used in the tests contained about 88% of fixed carbon, consequently, in order to obtain 12.2 parts of carbon, at least 13.86 parts of coke are required. As will be seen, a larger proportion of carbon was maintained in the experiments on account of losses, burning off at the surface, etc.

The ore had been concentrated from an ore containing only 30% of iron originally.

Coal and coke used in the briquettes were of good quality; the coal contained only 4.36 of ash, and 0.643 sulphur The ash in the coke varied between 9.15 and 10.15, and the sulphur between 0.59 and 0.85, while phosphorus was very low.

Manufacture of the Briquettes.—Ore and carbonaceous materials were first crushed to powder and then intimately mixed by hand. The proportions by weight were from 21 to 25 parts of coke and 27 to 30 parts of coal to 100 parts of ore.

Lime, to the extent of a little over 1% of the weight of the ore, was stirred in water and then added to the mixture, in order to constitute a flux of a given nature. The mass, after stirring, was formed by hand in special moulds into briquettes of 50 to 60 lbs. each. These were left to dry in the air for 10 days at least, under cover; and about 24 hours before being used in the furnace, they were put in a drying oven in order to remove the last traces of water and to heat them somewhat, though not so much but that they could be charged by hand into the furnace.

The slow drying of the briquettes imparted to them a certain compactness due to the more or less complete hydration of the iron ore. Furthermore, it was intended to render less objectionable the presence of the large amount of sulphur by transforming, partly through prolonged exposure to the air in presence of humidity, the sulphide of iron in the ore mixture into sulphate of iron in which state it can be eliminated with the slag during the heat. All the heats made at Croton magnetic mine were, in their general features, carried on in the following manner:

Conduct of the Heats.—First, the whole amount of pig iron and scrap to be used in the heat was charged at once and allowed to heat up. When it began to become pasty and to melt partly, the charging of the ore briquettes still warm from the drying oven was begun. These briquettes were laid side by side, as evenly as possible, over the surface of the metal bath, into which they at once partially sank. When, for any reason, the briquettes could not be charged all at once, the heat was left to itself for about half an hour, and then the remaining briquettes were charged in places where they could sink at once partially into the bath.

As soon as the whole charge was in the furnace, the heat was left to itself. In most of the heats, but specially in the later ones, the reaction began at once. Numerous blue flames covered the whole surface. The cinder, which at the beginning of the heat was black and very rich in iron, brightened up toward the end of the heat and appeared either dark bottle-green or light yellowish-green, like blast furnace cinder.

In order to obtain a quick reaction between the carbon of the metallic bath and the layer of the rich ferruginous cinder on top of it, the maintenance of a very high temperature in the furnace is essential. Otherwise the reaction will be slow, and the reduction of the iron from the ferruginous cinder incomplete. On the other hand, during an unduly prolonged heat the acid lining of the furnace will be destroyed very rapidly. Tests of metal were taken from time, and ore in lumps was added whenever it was found necessary. In the last heats made, the amount of ore thus added in lumps was largely reduced, and served rather for refining purposes. As soon as the tests of metal and the quietness of the bath in the furnace indicated a sufficient decarburization, ferro-manganese was added, and the metal was cast as in the ordinary open hearth process.

The author then describes in detail the results obtained in each of the 10 heats. The work was conducted under many difficulties on account of its experimental nature. The furnace used was a 10-ton open hearth furnace, which had been idle for about a year. The sand bottom was not well made and in many of the heats gave trouble by rising and covering the bath. There were no proper facilities for drying the briquettes, and as a consequence during the first heats the briquettes crumbled badly. A long interval had to elapse between heats, and the temperature of the furnace was too low for proper working in several cases.

The result of these drawbacks was that in the first few heats the slag was thick and pasty, the heat was very long, and a large quantity of iron, although reduced from the ore, was carried off in the slag in the form of metallic globules. The loss of iron in the first four heats was from 20% to 25%. In the fifth heat the furnace was much hotter, the heat was shorter, and the loss was reduced to 15.6%. But in the sixth heat even better results were obtained, and the loss was reduced to 9.16%.

The working of the process was interrupted at this point for several days. In test No. 7, notwithstanding a defective bottom in the furnace, the loss was only 10.2%, a considerable part of which was due to the loss of iron in the slag in the form of metallic globules. After another interruption of several days an ordinary open hearth pig and scrap heat was made, which showed a loss of 15.5%. The two final heats were then made, of which one showed a loss of 26.6% and the other a loss of only 4.90%, due partially to the recovery of iron which had settled on the bottom in previous heats. In both heats the bottom gave trouble by rising, but in the last heat, which was the largest and hottest made, the slag was very thin and fluid, so that the former loss of iron in the slag in the form of metallic globules did not take place.

Taking the total iron charged and the total iron produced in the ten heats, the loss was only 14.7%. Considering the many disadvantages under which the work was carried on and the knowledge gained as to the causes of loss, the author thinks the experimental work proves that the process can be carried on in regular work with an average loss of not over 10%.

The precautions necessary to secure such results with the Imperatori process are: 1. To use good sand and a well made furnace lining. 2. To dry the briquettes thoroughly for 8 or 10 days in the open air under cover and for 24 hours in a drying oven. 3. To charge them only after the pig iron and scrap previously charged have constituted by their partial fusion a metallic bath, into which the briquettes will partially sink and begin at once the reaction between the carbon and the ore and the formation of iron sponge. 4. To heat the furnace thoroughly before charging begins and maintain the temperature as high as possible.

QUALITY OF STEEL OBTAINED.

The steel produced contained a high percentage of sulphur, the ore not having been sufficiently roasted before concentration, and the scrap used having also much sulphur and phosphorus. Of course in the acid open hearth process these elements cannot be removed, and good materials must be put into the furnace to obtain good steel. No trouble was found in eliminating carbon, however. The first heat was stopped intentionally before the carbon had been thoroughly reduced; but in the remaining heats the percentage of carbon varied from 0.15 to 0.31. It is no more difficult in the Imperatori process than in the ordinary open hearth process to bring the carbon down to a desired limit.

The author concludes by comparing the cost of the ordinary open hearth process and the Imperatori process, as follows:

The cost of one ton of steel in the two processes depends on:

1. The prices of the raw materials used in the charge and their relative proportion. 2. Labor. 3. Furnace repairs. 4. The number of charges made per 24 hours.

As to the price and proportions of raw materials, it has been found at the steel works of Savona, Italy, where the Imperatori process was first used, and where the excellent results obtained since its introduction, both as to quality of steel and economy of operation, have led to its final adoption in current daily practice, that the amount of scrap used in the charge ought not to be higher than about 25%, and even less, if possible. The average composition of a charge in this process may be given as follows: 40 pig iron, 20 scrap, 40 ore in briquettes.

In the ordinary open hearth furnace the composition of the charge varies largely with the supply of scrap, but may be taken to be, on an average, 30 pig iron to 70 scrap.

We may assume for a calculation the price of pig iron at $19 a ton, and that of scrap iron at $21 a ton. The cost of the ore briquettes may be estimated as follows:

Ore, crushed, ground and concentrated to 64% of iron can easily be obtained in ordinary practice at 5 cts. a unit (and in many places at a cheaper rate), so that a ton of such ore will cost $3.20. Coke can be obtained at the rate of $4 per ton, and anthracite coal, which would be very good to use in these briquettes, is as cheap or cheaper. But as the coke or coal has to be ground to a fine powder, we will suppose it to cost even $5 a ton. Briquettes of a good composition will contain about 21 parts coke to 100 ore; in other words, a ton of ore will require 0.21 ton of coke. Briquettes containing a ton of ore will then cost:

1 ton of ore	$3.20
0.21 ton of coke at $5	1.05
	$4.25

But a ton of metallic iron requires the use of 1.56 ton of 64% ore, and will cost $1.56 \times \$4.25 = \$6.63$.

The labor in both cases will be the same, except for the making and drying of the briquettes. In current practice these briquettes will be made by machinery, and it will require only a few men to make from 800 to 1,000 briquettes a day, weighing each 50 to 60 lbs., so that they can be made very cheap. As a liberal estimate, we will take 50 cts. per ton of ore, so that the final expense per ton of iron in the ore would amount to:

Ore and coal (both ground)	$6.63
Labor on 1.56 ton of ore at 50 cts. per ton	0.78
Total cost of briquettes containing 1 ton metallic iron	$7.41

We have now to consider the repairs to the furnace and number of charges made per 24 hours. The average total duration of a test heat, as previously stated, was 8 h. 50 min., while the corresponding time in the ordinary pig and scrap process is about 8 hours; this would make a difference of about 1 hour in the time required.

Now, in the ordinary pig and scrap process the amount of gas coal consumed amounts to about 30% of the weight of steel obtained. Consequently, if the charge in the Imperatori process were to last about 1 hour longer, it will require about ⅛ of coal more, or say in all about 34% of the weight of steel.

As to repairs, it has been already stated, and with the ordinary so-called ore process it has been demonstrated at many works in Europe, that a neutral lining will require very little repairs and will last for several hundred heats; so that the expense of relining can be considered to be the same in both cases.

The same might be said of the number of heats in 24 hours. This number, as is well known, depends largely on the repairs required by the furnace. As these repairs will not be heavier in one case than in the other, we may say that practically the same number of heats can be made in both cases in 24 hours.

If we admit, furthermore, that the loss of iron in the pig and scrap process is about 10% and that this loss in the Imperatori process will not be higher, as has actually been shown for this latter process, by several heats during the tests (and it is even lower than 10%, according to the tests made in Europe), we can easily establish, as to the cost of steel in the two processes, a comparison which may be confined to those items which constitute the difference between them.

ORDINARY PIG AND SCRAP PROCESS.

One ton of iron charged—Pig iron, 0.30 @ $19	$5.70
One ton of iron charged—Scrap, 0.70 @ $21	14.70
Loss, 10%; hence, cost of 0.9 ton product	$20.40
" 1. " "	22.67

IMPERATORI PROCESS.

0.40 ton pig iron, at $19	$7 60
0.20 scrap, at $21	4.20
0.26 iron in 40% ore, at $7.41	2.96
0.86 ton iron charged	$14.76
Hence, 1 ton of iron charged (or, after allowing for 10% loss, 0.9 ton of product), would cost	17.16
Or, cost of 1 ton of product	19.06
To which must be added 4% excess of gas coal over the 30% of the weight of the steel which is required in the ordinary process, or 0.04 ton, at $3	0.12
Making a total for material and fuel of	$19.18

The difference in favor of the Imperatori process is $3.49 per net ton of steel obtained. This economy is important, but it does not constitute the only advantage of the process. In an average charge in the Imperatori process, composed, as has been said, of 40 pig, 20 scrap and 40 ore, the chemical composition of each constituent can be accurately ascertained. The pig iron will generally be low in silicon, sulphur and phosphorus; such iron can easily be obtained at reasonable price. The scrap used can be wholly supplied by the crop ends, rail-ends, etc., from the works themselves, no outside scrap being needed; consequently its chemical composition will be the same as that of the finished product, and can always be relied upon.

As to the ores used in the briquettes, there will be no difficulty in securing at low rates, concentrated ores (not much used at present) almost free from phosphorus and sulphur, and consequently constituting an excellent material for the production of the best quality of steel.

The carbonaceous material for the briquettes may be either coal or coke or charcoal or anthracite, as long as it does not contain too high a percentage of sulphur. Charcoal is very well adapted to this process, as it is very generally free from sulphur and phosphorus. Thus the well known chemical composition of the raw materials used will allow of obtaining, at a low price, a very good quality of steel, which is not always obtainable in the ordinary pig and scrap process.

Another very advantageous feature of the Imperatori process is the facility with which many ores, hitherto almost useless, could be treated, thus enlarging the market, now very limited. Thus, many lean ores largely found in the States of New York and New Jersey, and, in

fact, in almost every one of the United States, would constitute, when once ground and concentrated, an excellent material for this process.

In Morris County, New Jersey, ores are mined containing only from 30 to 37% iron, with 0.085 sulphur and 0.06 phosphorus, which, concentrated, furnish powdered ore containing 64 to 65 iron, 0.02 sulphur and 0.02 to 0.03, or even less phosphorus. These are well adapted to be used in the Imperatori process.

Besides these concentrates, most of the magnetic sands found in large deposits in Canada and in the United States, and containing a high percentage of iron (as high as 66% in certain cases), could be made available by this process. Many of these sands, if not rich, are physically associated with earthy substances which a simple washing could remove, furnishing a practically almost pure oxide of iron in powder, at a low price and particularly well adapted to be made up into briquettes.

Another advantage of this process is its easy adaptation to any existing open hearth plant, as it can be carried on in any existing furnace without the slightest alteration or addition.

The Laybourn Iron Flume.

One of the greatest objections to the use of woodeu irrigating flumes is the alternate shrinking and swelling of the wood and the consequent warping and distortion of the structures. To overcome this difficulty, and at the same to provide a durable substitute, easy of transportation and erection, Mr. M. H. LAYBOURN has designed and patented an iron flume which is illustrated herewith.

Galvanized iron is used for the trough of the flume, which is supported in various ways, according to the exigencies of the case, but generally by means of cast iron brackets placed on timber supports. Fig. 1 shows a small flume, supported on single posts. In this, as in other cases, the upper edge is stiffened by means of a board or plank, which also provides a means of fastening the flume to the bracket. Fig. 2 shows a larger flume, circular in section, supported by a bracket at each side resting on a horizontal timber. In both these cases the board beneath the flume may be omitted, but it aids in erection, and adds stability to the structure. The smaller sizes, Figs. 1 and 2, do not have riveted connections between joints, and therefore, especially in the use of the single post support, may be easily moved from one locality to another.

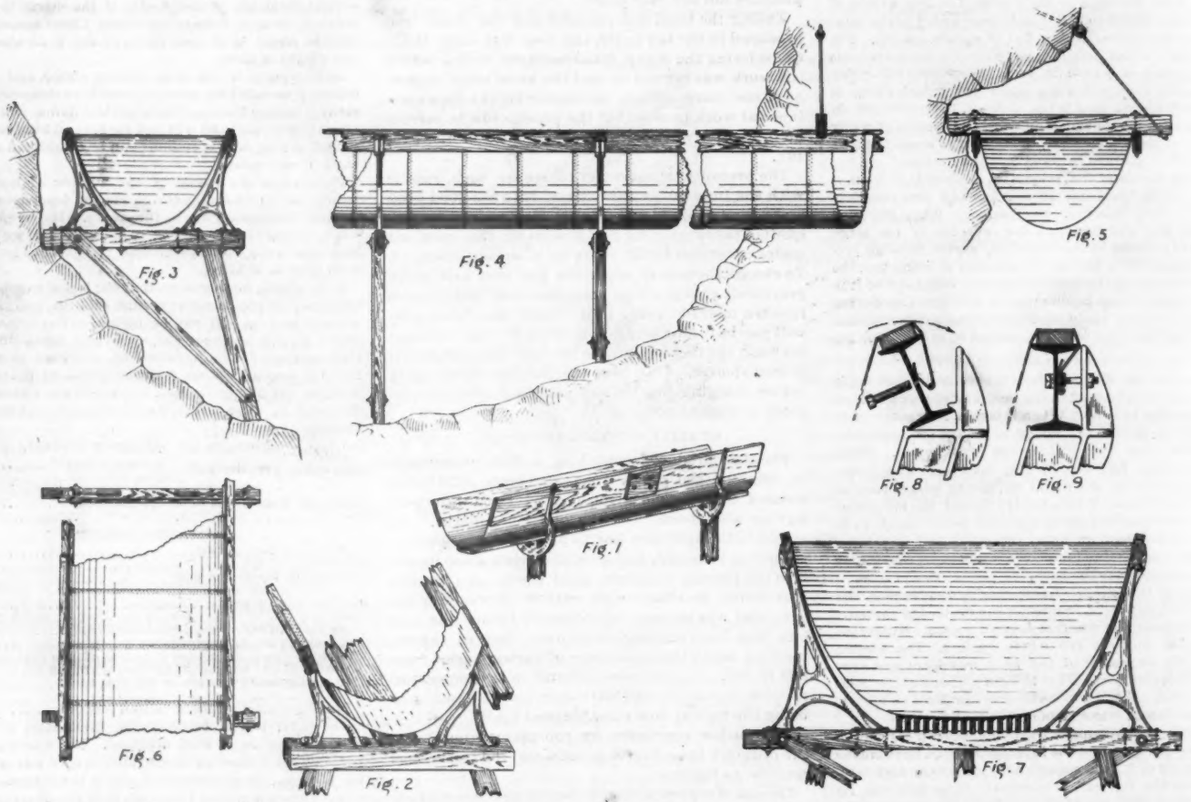
The general shape of the flumes, in section, is parabolic. Where the depth is restricted and the volume of water to be carried is large, the type shown by Fig. 7 is adopted, the sides being parabolic and the bottom circular. In this case the bottom of the flume is supported throughout its entire length by plank or timber on edge, let down into the sill of the trestle to conform to the shape of the flume.

In case it is desired to substitute iron for the timber supports the all-metal structure shown by Figs. 8 and 9 is used. This consists of rolled steel or iron I beams resting on cast iron vertical supports, the shell of the flume being secured to the beams in the manner shown.

Figs. 3, 4 and 5 show how admirably this form of flume may be adapted to a rough country by resting one end of the sills on a precipitous rock wall and supporting the other on timbers, or by means of rods and eyebolts driven into an overhanging cliff. Fig. 6 shows the flume in plan.

Either galvanized iron, black iron or asphalted sheet iron may be used for the trough. All the metal used in constructing the flume is, or may be, if desired, shipped with it, so the erection is very simple. For the larger sizes expansion and compression joints are provided.

The flume seems an excellent one, and likely to be quite widely used. It is manufactured by the Irrigation Machinery Co., Denver, Col. We are indebted to Martin, Aulls & Follett also of Denver, for the above information and the illustrations.



GALVANIZED IRON IRRIGATING FLUMES.

Additional Notes on the Cascade Tunnel.

Since the publication of Mr. HOBART'S description of this work in our last two issues, we have received the following additional particulars concerning the work, from the engineers in charge of the location and construction of the tunnel:

Stampede pass across the Cascade range, beneath which this tunnel was driven, was discovered on March 19, 1881, by a party sent out by Mr. V. G. BOGUE, then Principal Assistant Engineer of the Northern Pacific R.R. The existence of a pass at this point had been suspected, but was not known prior to this date; and the party was sent out to find the pass, if it existed.

The height of the mountain above the tunnel is 1,135 ft., instead of the figure given on page 302 of our issue of Oct. 3.

The switchback over the mountain, over which trains were run during the construction of the tunnel, was executed by Messrs. W. H. KENNEDY and J. Q. BARLOW, under the direction of Mr. H. S. HUSON, as before stated.

In timbering the tunnel, the work was usually done on wall plates. These, with their load of segments, lagging and packing, spanned the space between the last set of posts and the rock of the bench. Additional sets of posts were placed as the excavation progressed.

The breaking shot which established an opening betwen the east and west headings was fired in the latter on May 3, 1888, as stated. The excavation was completed May 10, and the first regular train ran through the tunnel on May 27.

The line and levels of the engineers working from each end checked as follows: Alinement, 0.046 ft.; grade, 0.03 ft.; distance, 0.60 ft.

During the month of June, 1888, the Commissioners appointed by the United States Government to inspect and accept the successive sections of the main line of the Northern Pacific road, were taken through the tunnel by Mr. J. W. KENDRICK, Chief Engineer of the road, thus completing the acceptance of the entire line, by the acceptance of this last part, the most costly work yet done in the West.

The amount of excavation for the tunnel section was 12.36 cu. yds. per lin. ft. for rock section and 15.70 cu. yds. for the sections where timbering was required instead of the figures given last week.

In the work of lining the tunnel with a concrete arch now in progress, it may be of interest to note that the sand and cement are mixed dry by a worm mixer at the place where they are to be used. The power for the mixer is furnished by an Edison 6 kilo-watt, 1,000-volt motor, supplied with current from the lighting dynamo at the east portal of the tunnel.

Tandem Tanks for Hoisting Water from Flooded Slopes.*

The water-hoisting tanks herewith illustrated have been designed for removing large quantities of water from recently flooded mines, through their hoisting-slopes, with rapidity proportional to the capabilities of the hoisting machinery available, the tanks being adaptable to slopes of small sectional areas and varying pitches.

The following features may be of interest to those operating mines liable to be flooded:

1. The arrangement of doors on each tank by which it may be automatically filled by immersion at any point on the varying pitch of a slope, the water being retained while hoisting on the flat as well as on the steep pitches, and quickly and automatically discharged at the top.

2. The arrangement, in connection with the above-mentioned doors, of side wheels over the rear wheels of each tank and of side-dumping tracks at the top of the hoist, for the automatic emptying and quick return of the tank.

3. The arrangement of two or more tanks, one in front of the other, so as to give as large a capacity in a single hoist as the engine power will permit, yet without making any tank too large for the sectional area of the slope, or of unwieldy length, or of such a shape that it cannot pass easily over vertical curves, and without concentrating too much weight on any one pair of wheels or on any point of the track.

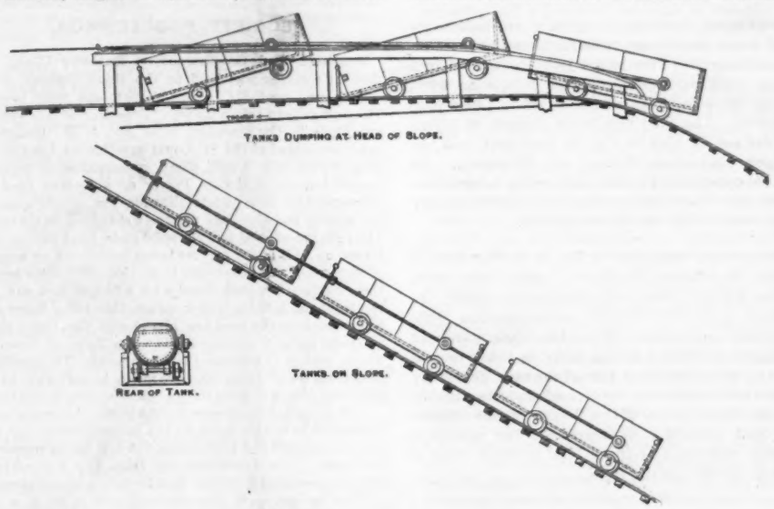


FIG. 1. WATER-HOISTING TANKS.

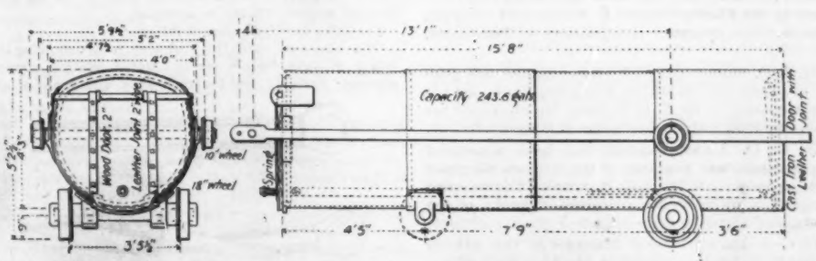


FIG. 2. DETAILS OF HOISTING TANK.

The details of construction and method of operating are shown by the accompanying sketches (Figs. 1 and 2) and the following more detailed description.

At the end of each tank is a large iron door of almost the full size of the end of the tank, opening inward, so that when immersed the tanks fill almost instantly. To provide for holding the water while it is hoisted up flat pitches, a wooden door is attached to the front of each tank, opening outward. Each front door is attached to the door at the back by an iron rod, provided with a sliding link so that the back door can open independently of the front; but the latter is held closed as long as the rear door is closed. This connecting rod, as shown in Fig. 2, passes through the front door and through a spiral spring in front of it, so that the amount of pressure necessary to keep the water from leaking out may be readily applied.

The tanks are mounted on self-oiling closed wheels, so arranged as to exclude water from the bearings while the tanks are immersed, and to retain the lubricant.

Each tank is provided also with side wheels, vertically over the rear axle, which have a gage sufficiently wide to clear all other portions of the tank; and on the surface an elevated track is provided, upon which these dumping wheels run and thus raise the rear end of each tank as much as may be necessary to dump the water into a trough between the tracks; the tilting forward of the tanks opening the back door and releasing the front one. The tanks while emptying rest on their forward wheels and on the dumping wheels. By having the tracks at the surface slightly up-grade, the tanks will run back when empty, as soon as the rope is slackened. To allow this dumping, the hoisting rope is attached to the tanks by a yoke reaching back on the sides and pivoting on the axle of the dumping wheels, the tanks back of the first one being attached by eye-bars reaching from axle to axle of the dumping wheels on the tanks. A stop is provided to prevent the yoke on the forward tank from dropping and catching in the track when the rope is slackened.

This plan of "tandem tanks" was designed and used to hoist about 25,000,000 galls. of water which had been admitted to extinguish a mine fire in one of the Susquehanna Coal Company's mines. The slope was small in section and 3,200 ft. long, with single track, and with pitches varying from 4° to 20°. The hoisting plant consisted of a pair of 26 × 60 in. direct acting engines with cast coned drum, 9 to 12 ft. in diameter, carrying 1⅝-in. steel rope. These engines had been previously hoisting 5 cars, weighing about 4 tons each when loaded.

* A paper by Mr. J. H. BOWDEN, Wilkesbarre, Pa., read at the Glen Summit Meeting of the American Institute of Mining Engineers.

Notes of a Vacation Trip from New York to Salt Lake City and Return.

(*Continued from page 332.*)

Governor Arthur L. Thomas, of Utah, may be ranked among the notable men of the times. He is still a young man and only a few years ago was a page in one of the houses of Congress at Washington. Sent to Utah in a clerical capacity in 1879 he has rapidly risen to the office of chief executive of the territory, and so far as I could learn, is deservedly popular. He has taken great personal interest in the reclamation of the vast arid regions of Utah and adjacent territories, and at his suggestion a meeting of the Chamber of Commerce of Salt Lake City was held on June 3 last, when a resolution was passed requesting him to call a convention to meet at Salt Lake City. The Irrigation Congress was the result of the call made by the Governor June 12 and addressed to the governors of all states and territories west of the Missouri River. The purpose of the Congress was "to consider matters pertaining to the reclamation of the arid public lands of the West and to petition Congress to cede to each state and territory the arid lands within its borders for purposes of reclamation, for the support of its public schools and for such other public purposes as the legislatures of each state or territory may respectively determine."

There was a prompt and liberal response to the call of Governor Thomas, showing the deep interest taken in the subject of irrigation throughout the country west of the Missouri. On the morning of the 13th the large hall of the Exposition Building was filled with delegates to the Congress; the press was well represented from San Francisco to Chicago, besides ENGINEERING NEWS from New York and an English syndicate from London. There was nothing of the "hayseed," the "cowboy" or the "wild and woolly west" nature about that body of delegates. They were as fine looking, intelligent and wide awake body of men as can be convened in any section of the United States. U. S. Senator Wm. A. Stewart, the advocate of unrestricted silver coinage, was a delegate from Nevada; U. S. District Judge V. H. Grinstead, of Kansas; Probate Judge Jas. McGarry and Civil Engineer A. D. Foote, of Idaho; Governor, City Mayor, President of Board of Trade, lawyers and editors, besides farmers with an extended practical knowledge of irrigating represented Utah; F. C. Finkle, C. E., from San Bernardino, whose papers on irrigation in that county have recently been published in ENGINEERING NEWS; Elwood Mead, the State Engineer of Wyoming; Andrew Gilchrist, Bank President and also President of the largest irrigation enterprise in Wyoming; R. Chatten, a prominent California ranchman; Civil Engineer Gen. H. S. Willey, of San Francisco; Wm. H. Hall, ex State Engineer of California and a well-known authority on irrigation; C. W. Irish, C. E., formerly of Iowa, recently Surveyor General of Nevada; Prof. L. G. Carpenter, Professor of Irrigation Engineering at the Colorado State College at Fort Collins; State Senator C. W. Sanborn, of Boulder, Colo.; Messrs. Green, Martin and Anderson, all irrigating engineers of Denver; M. M. Estee, of California, one of the best, if not the best posted man on irrigation in the United States and a possible U. S. Cabinet official, with J. P. Irish, a prominent San Francisco newspaper writer. These were a few of the many notable men of the Congress sent to discuss the important problems set forth in the call of Governor Thomas. The organization of the convention and the result of the three days' discussion have already been published on page 225, ENGINEERING NEWS.

The discussion on the second day especially, when the congress met as a "Committee of the Whole" with Senator Stewart as chairman, was interesting and instructive. There was a resolute squelching of pure bombast and politics, and the main subject was attended to very closely. While solid business was adhered to in most of the speeches, there was considerable humor to lighten it up. The great speech of the day was made by W. H. MILLS, the land agent of the Southern Pacific Ry. system; the witty speech by Judge C. C. GOODWIN, editor of the Salt Lake *Tribune*. Mr. MILLS remarked that the results of irrigation on fruit raising in California were so remarkable that if a man should tell the whole truth, and nothing but the truth, he would be called an unblushing liar. Of these remarkable results of irrigation in California and Idaho there was no end of stories told in the hotels by enthusiastic delegates and visitors. There was no reason to dispute their entire veracity, and there are undoubtedly splendid opportunities to make money in these arid countries by intelligent and active men with some capital, who will engage in fruit raising.

The effect of this Irrigation Congress will not be felt immediately. It will be, however, later on when the process of educating the American people to the importance of the subject and its future benefits to the nation, begins and progresses. Civil engineers are very much interested in the promotion of irrigation enterprises: in Salt Lake City, in Leadville and in Denver, in conversation with engineers, there was but one opinion as to civil engineering work in the far West. Mining and irrigation were the only branches worth paying special attention to; there will be a small amount of municipal and some railway work, but mining and hydraulics are the only sources of profit for the civil engineer.

Leaving Salt Lake City at 9 P. M., by the Rio Grande Western R. R., Junction City is reached in time for breakfast. Trains are made up there for Denver by the D. & R. G. broad gage, via Leadville, by the D. & R. G. narrow gage, over Marshall Pass, and by the Colorado Midland to Denver, via Leadville and Colorado Springs. There was a grand fruit and vegetable "Exposition" holding through the week, and I was there the day following "Peach Day," when free peaches were the order, and many tons were distributed 'without money and without price.' Peaches were being hawked on the station platform while the trains were being made up; they were very cheap, and they were certainly the finest specimens of that delicious fruit I ever saw, and I have seen the best that the New York markets supply. Enormously large and hand some peaches from California were on exhibition at Salt Lake City during the Congress, but, like the same fruit exposed for sale in New York, they were "cingaleses," o the most exasperating species, the flavor was insipid and

the grain of the fruit coarse. The Junction City peaches were almost transparent in their clearness, the flavor was of the "peachiest" quality, and they were "freestones," without a detracting characteristic. As a peach growing district, the Junction City lands are without a superior, if, indeed, they have an equal, in America.

Every railway system nowadays has a pet sanitarium or hotel to attract tourists and local excursion parties. Glenwood Springs is the favorite of the Colorado Midland, and the train waits there one hour to allow passengers to be hauled up to a hotel in the town, where they can spend 75 cents on a lunch, which is dear at any price, or go over to the Sulphur Springs and take a bath. I took the lunch and then visited the bathhouse and pool. The water issues in an immense volume from the ground, so hot that it is unbearable to the hand; it runs from the well to the elliptical pool, which is several hundred feet long and about 50 ft. wide; it is exceedingly sulphurous, but as it runs from one of the wells after cooling a little it is not unpleasant to the taste. One of the passengers from the train who took the bath said that it left him rather enervated and he regretted taking the plunge. The bathhouse is a most expensively fitted up institution; it is a gem of architecture in its way and a study in handsome fitting and furnishing. The principal stockholders in the enterprise are the President and Vice-President of the Bank of England, who also own large interests in the railway.

The Busk-Ivanhoe tunnel entrances are passed just at night fall as the train begins the ascent of the mountain which is being tunneled. Leadville was reached at 9 P. M. It is unfortunate for tourists who wish to look at mountain scenery that the Colorado Midland runs through the most interesting portion of its route in the night time going either way; there is to be a change I understand, and two more trains will be run, one each way, giving tourists the benefit of daylight. By taking a ticket over the D. & R. G., and laying over at Leadville, some of the finest views of the Rocky Mountain cañons can be seen.

In Leadville I was the guest of Mr. John Williams, Assistant President and General Manager of the Consolidated Kansas City Smelting & Refining Co., formerly associate editor of the *Engineering and Mining Journal*. The smelting and refining works, now under Mr. Williams' management, are the most extensive silver smelting works in America, and second only to some Swansea, Wales, works. The ore is smelted at Leadville and then shipped in "pigs" to Argentine, near Kansas City, and to Denver for refining. The works handle about 400 tons of ore daily, and they pay freight bills of about one million of dollars annually. The company buys the ore direct and handles it at its own convenience. It was my first visit to a silver smelting works and I was much interested, and herewith beg leave to express my thanks to Mr. Williams and also to Mr. Kearney, son of the late Gen. Phil. Kearney, U. S. A., the agent of the company at Salt Lake City, for many courtesies extended to me in Salt Lake City and Leadville.

The morning at Leadville was consumed by the visit to the smelting works. After lunch I had the good fortune to be the guest of Thos. W. Jaycox, Civil Engineer, formerly of the Sewer Department, Washington, D. C., more recently City Engineer, and last year the Mayor of Leadville. Under Mr. Jaycox's intelligent guidance we made the tour of the mining district of Leadville, said to be the largest "mining camp" in the world. I will not attempt a description, but it was very interesting to look at the "holes in the ground" from which millions of dollars have been and are still being drawn out to the enrichment of many men, while numerous other "holes" show where large fortunes and larger hopes have disappeared forever. Mr. Jaycox has made hydraulics a study during his entire professional career; he is now mostly in demand as a mining engineer and an expert on mine surveys, and probably has no superiors in the profession in the mining regions. Another mining expert in Leadville is Chas. J. Moore, who was the first editor and part owner of ENGINEERING NEWS, in 1874, but who has been intimately associated with the development of the Leadville mines since 1879, and who is now consulted on most of the intricate questions of boundaries and development of mining property in the vicinity of Leadville. According to all accounts to which I listened, the output at Leadville is not satisfactory at present. "Business is dull," but it is the unanimous opinion of those competent to judge that the possibilities of Leadville are yet unknown, that the ground is but "scratched," as it were, and that far greater fortunes are yet to be dug out of the hills thereabouts than have yet been secured.

People who live in Leadville are there for money, not pleasure or comfort. The town is not a camp of "roughs" and "toughs," but is as orderly as any Pennsylvania mining town of equal size. The police force consists of seven men. There are some churches and a little of what might be called society. I met with a select coterie of very bright and intelligent men at a private club and was assured that with the exception of the pleasant diversion of the club hours the balance of the time was given exclusively to work. The town is 10,400 ft. above the sea level. I found that walking fast on the level or going up stairs increased the difficulty of breathing, otherwise there was nothing unusual from the experience at sea level. Persons with heart trouble do not stay long in that altitude; the acclimated residents find no difficulty except in keeping warm. Flannel underclothing is not uncomfortable at any season of the year. At the time I was visiting the smelting works, a fierce storm was raging on the mountain tops to the west, and it passed over Leadville with heavy hail and rain. Snow lies on the mountain tops in sight all the year through. Leadville is sewered by a private company, this making the fifth private system of sewerage in the United States reported thus far. Mr. Jaycox is the Engineer and a principal owner. Mr. C. N. Priddy, Engineer and Superintendent of the Water Co., is a stockholder; the system was planned and built for the personal benefit of a few enterprising citizens, afterward privileges to connect were sold, until it is now the generally adopted system. No franchise has been granted, but the projectors feel very secure in their monopoly.

Trains by the Colorado Midland leave Leadville at 9 P. M.: the descent to Colorado Springs is made by 3 A. M.; the trains are run cautiously along the mountain sides, around sharp curves and down steep grades, but one feels more comfortable in mind when the great mountains are left behind and the level mesa is reached. I arrived in Denver at 7 A. M., Saturday Sept. 19.

(To be continued.)

EIGHTY-FIVE TONS OF ALUMINUM are said to be wanted from American manufacturers by the German government. The metal is to be turned into buttons, buckles, telegraph and telephone wire, cartridge shells, and is also to be used in a new pontoon device. The only two firms capable of filling this order are the Cowles Co., of Lockport, and the Pittsburg Reduction Works, of Pittsburg. As these two companies are now engaged in a legal controversy that limits their output, the Germans may have to wait awhile for the aluminum.

A FOG-SIGNAL, designed by Mr. H. T. GRUNDY, of Radcliffe, Manchester, England, is said to have been in service for two years with satisfactory results. It consists of a whistle worked in conjunction with the ordinary semaphore. When the blade stands at the danger position a spring lever is made to rise so as to lie along the inner side of the rail. This lever is formed with a suitable curve, and projects slightly above the line of travel of the flange of the engine wheels, and when it is depressed by the wheels a peculiarly piercing "screech" is emitted from a whistle at the side of the track.

PERSONALS.

Mr. FRANK DAMON has been appointed Chief Engineer of the Florida Central & Western Ry., vice Mr. JOHN M. COOK, resigned. Headquarters at Tallahassee, Fla.

Mr. J. D. SHATTUCK, C. E., has resigned his position as engineer to the Walton Water Supply Co., and has been succeeded by Mr. E. F. MUSSON. Mr. SHATTUCK has taken a position with the Burlington & Missouri Ry. Co.

Mr. G. O. VANDEVANTER has been appointed Principal Assistant Engineer of the Western Maryland R. R., as assistant to Mr. J. E. MATTHEWS, Engineer and Roadmaster, owing to the continued ill health of the latter.

Mr. C. A. BECK, General Manager of the Illinois Central R. R., has been appointed Assistant Second Vice President, the office of general manager having been abolished and the duties assumed by the Second Vice-President.

Mr. HERMAN LAUB, who for some years past has been associated with Mr. G. LINDENTHAL, has opened an office in Sern's Block, Pittsburg, for the practice of engineering, especially in the department of iron and steel construction.

Mr. A. F. STEWART has been appointed Master Mechanic of the Cincinnati and Huntington Divisions of the Chesapeake & Ohio Ry., with headquarters at Huntington, W. Va., vice Mr. WM. HASSMAN, resigned to accept a position elsewhere.

Sir HENRY WOOD AND Mr. JAMES DREDGE, of London *Engineering*, the English Commissioners to the World's Fair, returned to England last week, and express themselves as greatly pleased with the plans and preparations already made for the Fair.

Mr. PRESCOTT METCALF, who died at Erie, Pa., Oct. 14, was one of the projectors of the Erie extension canal. Later he became a pioneer railway builder and was one of the constructors of the Erie & Pittsburg R. R. and the Erie & Northeast R. R., now a part of the Lake Shore & Michigan Southern Ry.

Mr. C. C. MARTIN, Chief Engineer and Superintendent of the Brooklyn Bridge, has had his salary raised from $6,000 to $8,000 per year. The resolution effecting this was accompanied with the most hearty and unanimous testimony as to the value of Mr. MARTIN'S services in connection with the bridge. Mr. MARTIN has declined the late flattering offer of the position of Managing Director of the Rensselaer Polytechnic Institute, at Troy, N. Y. Mr. SAMUEL PROBASCO, Assistant Engineer, has had his salary raised from $5,000 to $6,000.

Mr. ALBERT FINK is heartily recommended for the vacant place on the Interstate Commerce Commission, to be filled by the President. Mr. FINK is a practical business man, intimately acquainted with the intricacies of railway methods and management by reason of his long and successful service as Trunk Line Commissioner. His appointment would be an excellent one, if he will consent to accept it, probably the best which could be made.

Lieut.-Col. HENRY M. ROBERT, U. S. Engineer Corps, has been relieved from duty as Engineer Commissioner of the District of Columbia, and ordered to duty at Nashville, Tenn., relieving Lieut.-Col. JOHN W. BARLOW, U. S. Engineers. Capt. WILLIAM T. ROSSELL, U. S. Engineers, now on duty in the office of the Commissioners of the District, has been detailed to succeed Col. ROBERT as Engineer Commissioner. Col. BARLOW will remain at Nashville on special duty under the Secretary of State.

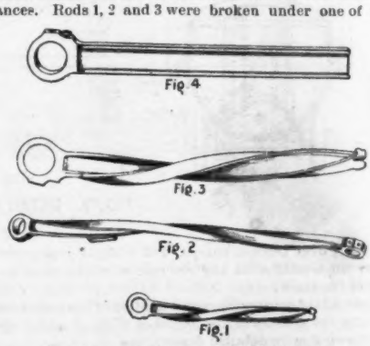
SOCIETY PROCEEDINGS.

Southern and Southwestern Railway Club.—The first fall meeting was held at the Hotel Duncan, Nashville, Tenn., Sept. 24. About 25 members were present. The first subject taken up was "Breakage of Locomotive Side Rods." The Secretary read Mr. J. W. Hemphill's paper presented at the St. Louis meeting on April 16 (see ENG. NEWS, May 9, 1891), also a communication from the Superintendent of Motive Power of a western road, accompanied by blue prints showing the construction of fluted solid end side rods used as a standard on that road. The rods are of steel and the solid ends have the oil cups forged on, this latter feature being introduced on account of losing so many brass cups in service. The main rods on these engines are each fitted with a forked back end, and the front end is fitted with a strap, this strap being necessary because the road has abandoned the Laird guide and substituted a two-bar guide and a form of crosshead which makes it necessary to use a strap. The quality of steel from which these rods are made is indicated by the following abstract from the specifications for the material:

"All blooms to be of open-hearth steel. One end of each bloom will be drawn down by the manufacturer to a test bar 2 ins. square and 10 ins. long, the test bar to remain on the bloom. A test specimen cut from this bar midway between center and outside should show a tensile strength of 75,000 lbs. per sq. in., and an elongation of 23% in a test section originally ⅝ in. diameter and 4 ins. long. Steel having more than 80,000 or less than 70,000 lbs. per sq. in. tensile strength, or elongation less than 20% in the specified test section, will not be accepted."

The letter then continues as follows:

"We also send with this two blue prints showing the action of these rods in service, under adverse circumstance. Rods 1, 2 and 3 were broken under one of our



Breakage of Locomotive Side Rods.

eight-wheeled passenger engines. The immediate cause was the breaking of the rear driving wheel axle close to the hub of the right wheel, allowing the wheel to fly off and down the bank. This had no sooner occurred than the left hand back wheel also broke and went down the opposite side of the bank. Figs. 1 and 3 represent different views of the same rod. You will observe that it twisted to almost two spirals before it broke. The rod shown in Fig. 2 did not break it; it merely got one complete twist. This shows remarkably fine material.

"A short time after this we had a rod, similar in design and on the same class of engine, break while the engine was running about 30 miles per hour. It did not twist but broke off short. There was no apparent reason for it unless the engine caught on sand on one side. We made laboratory tests of this material, expecting to find a marked difference in it. Rather to our surprise all showed well and everything was within our specifications. The results of the tests are as follows:

	Ult. strength lbs. per sq. in.	Per cent. elongation in 4 ins.
First rod (Figs. 1 and 3).....	72,100	25½ (twisted)
First rod (Figs. 1 and 3).....	73,100	28 (twisted)
Second rod (Fig. 2).....	70,700	29 (twisted)
Second rod (Fig. 2).....	71,000	28 (twisted)
Third rod (Fig. 4).....	70,700	24 (straight)
Third rod (Fig. 4).....	71,500	23 (straight)

These two instances which I have cited are the only cases in which our fluted rods have ever broken."

DISCUSSION.

Mr. James Meehan stated that he had made it a practice whenever rods were broken or cracked on his road to test the material; and he had found that while the metal might be excellent in some parts of the rod, if he took a test piece as close to the broken surface or crack as possible, he would find the structure was entirely different from the remainder of the rod. It was frequently crystallized, the crystals being very coarse, and the material showed signs of fatigue in every way. He concluded, therefore, that the vibrations of the rods were localized at the point of fracture, and for this reason that part of the rod had been gradually reduced to an unsafe condition, and had finally cracked or broken. He frequently found this crystalline structure for three or four inches on each side of the break or crack. He had for eight years forged his rods out of selected scrap, and none of these rods had ever broken. This, however, he believed was due to the care with which they were watched, because a number of them had cracked. He is now trying basic steel for rods, and believes it will be better than the Bessemer steel, because it contains less silicon and phosphorus than the latter. As to the form of rod, he had used the solid end parallel rod for nearly nine years. He also had tried solid ends for the back of the main rods, and some years ago had eight engines fitted in this manner. They gave excellent results, but there was one rather serious objection to the arrangement. Whenever it became necessary to put a new bushing in the back end of the main rod, the engine, if it was a passenger, had to be put in freight service for a few days in order to make sure that there would be no trouble from the bush and pin heating. With this one exception everything was most satisfactory; and if the motive power on a road was adequate to handle the traffic, there would be no difficulty with the arrangement. At the time, however, he was so short of motive power that it was a serious matter to take an engine from passenger service and put it into freight; and for that reason the bush was abandoned. As showing how serviceable such an arrangement is, he stated that one engine had made 127,000 miles without rebushing any of the rods, and that the bushings in the back end of the main rod were then in pretty fair condition. The brass was 5.5 to 1 and the crank pin was iron, case hardened. In making the brass, lead flux was used, and it caused more or less complaint from the molder as the metal was a little difficult to handle; but it made excellent bearings. He did not like case hardened steel, but when trying the basic steel he had experimented a little with case hardening and found that carbonated bone black was the only thing which could be used with satisfactory results. He did not believe in high grade steel for parallel rods and thought that the tensile strength named in the specifications above was too high.

Mr. W. H. Thomas, of the East Tennessee, Virginia & Georgia, stated that he had no trouble with heavy rods breaking, but that the light rods which were put in service years ago occasionally broke. They were all made of iron and had straps and keys.

Mr. J. J. Casey had had about a half dozen rods broken in the last few years, and had noticed that each of them had run about 150,000 miles. They were all rods of rectangular section, fitted with straps and keys. He believed these rods were liable to failure after having made a certain mileage. His standard is now a solid end rod, with oil cup forged on. He has used fluted rods for some time and has had none of them break.

Secretary Marshall called attention to the fact that cracking in rod ends often starts at the sharp corners of the keyway and at the oil hole. Such cracks generally start on the interior of the head, next the brass. To guard against them oil caps are being forged on and straps are thickened at the keyways.

BEST FORM OF DRAFT GEAR FOR FREIGHT CARS.

A paper on this topic was presented by Mr. Robert Walker (M. K. & T.), at a meeting held last winter, in which the "American continuous draft gear" was commended. The cost per car is $4.87. The only objection to it is the gradual slackening of the rods; and this can be obviated by offsetting the drawbar keys at each end of the car ¾ in., so that the slack can be taken up. Turnbuckles are also used. Mr. Steinbrenner had had trouble with broken springs in using this draw gear, and favored the Butler draw bar attachment in combination with it. This prevents the breaking of springs and pushing in of draw bar stops, and reduces by six the number of bolts through the draft timbers.

Mr. J. J. Casey had 700 cars with the "American continuous draw gear;" and while he also had had trouble with breaking springs, he thought it saved 75% of the cost of maintenance of draw gear. He thought the cost of the "American" gear was $7.20 per car instead of the amount stated by Mr. Walker.

In reply to some criticisms on the Butler attachment, it was shown that as now made, of malleable iron, breakages are few; the old form with cast iron parts had caused some trouble, especially on 60,000 lb. cars. The advantages of placing the draft gear between the center sills, as practiced on the Chicago, Burlington & Quincy and the Denver & Rio Grande, were described by Secretary Marshall.

The election of officers resulted as follows: President, R. D. Wade, Rich. & Danville; First Vice-President, Pulaski Leeds, L. & N.; Second Vice-President, Jas. Meehan, Queen & Crescent; Treasurer, A. G. Steinbrenner, Am. Refrig. Transit Co.; Secretary W. H. Marshall having resigned, that office was left vacant.

The secretary's report showed a total membership of 86. The total receipts from dues and from advertising in the published "Transactions" were $597. The total expenditures were $473.

There was some discussion over the question of choosing a permanent place of meeting and changing the number of meetings per year from six to five. Notice was given that an amendment to the constitution will be voted on at the next regular meeting, to be held at Atlanta on Nov. 19, fixing Atlanta as the permanent place of meeting and changing the number of meetings as stated. At that meeting also Mr. W. H. Thomas will present a paper on the best manner of conducting repair work on large systems, and Mr. James Meehan will have a paper on Uniformity in Locomotive Performance Sheets.

Engineers' Club of Philadelphia.—Regular meeting, Oct. 3, 1891. President Wilfred Lewis in the chair; present 39 members and 3 visitors. The subject announced for the evening was "Power Transmission," but with the consent of the Committee on Information and Entertainment, Mr. John C. Trautwine, Jr., read a paper compiled from data furnished by Capt. Spencer C. McCorkle, upon "Land-locked Navigation from New York City to Charleston, S. C." Advance copies of this paper, which concludes with a proposed series of resolutions memorializing Congress in behalf of the scheme, were mailed to members with the notices of the meeting. The secretary read a written discussion received from Mr. J. Foster Crowell, of New York. Mr. Crowell, from personal acquaintance with considerable portions of the proposed route, had, some years ago, been forcibly impressed with the extreme simplicity and feasibility of the plan. He has, in time past, contended that such action as is contemplated by the proposed resolution is an entirely proper exercise of the club's public function; and in the present discussion he submits, as a substitute, a preamble and resolution to the same general effect, but seeking to avoid the appearance of soliciting Government aid for the civil engineering profession. The resolution, furthermore, confined its petition to the eastern portion of the route, between New York Bay and the St. John's River in Florida.

The paper was discussed by Captain McCorkle, Mr. Rudolph Hering and Mr. T. Carpenter Smith. Captain McCorkle urged the importance of the project, but was quite willing to waive the matter of a petition to Congress, being satisfied with the substantial endorsement of the club, expressed by its publication of the papers in its proceedings. Mr. Hering, while believing that such a system of navigation would be of value chiefly to local traffic, and although not prepared to vote for the resolutions submitted, heartily indorsed the general project.

Mr. Smith, speaking in behalf of the yachting fraternity, set forth some of the advantages it would derive from such a means of communication. On motion it was resolved that the resolutions offered should be considered at the next business meeting.

The subject for the evening, "Power Transmission," was then taken up. Mr. T. Carpenter Smith read, for Mr. Saunders Morris, a paper on "Electrical Transmission of Power," an abstract of which appeared in the notice for the meeting. The secretary read, for Mr. Coleman Sellers, a letter communicating information obtained from recent letters from Switzerland respecting the electric transmission of power from Lauffen to Frankfort, a distance of 175 kilometers, or about 109 miles. A 300 HP. turbine at Lauffen supplies power to a three-phase dynamo which furnishes currents of 65 volts, which are at once transformed to 25,000 volts and carried to Frankfort by a three-wire-line, each wire having a diameter of 4 mm. The wires are carried by porcelain insulators with oil grooves, on wooden poles about 50 m. (164 ft.) apart. At Frankfort, the high tension current is re-transformed to an alternating current of 65 volts. This current supplied (on the evening of Sept. 14) 1,000 incandescent 16 candle lamps and a three-phase receiving dynamo of 100 HP. From considerations of safety, the horse-power developed at Frankfort has not yet exceeded 120 HP., and the tension actually used has not exceeded 15,000 volts, the quantity reaching only 1,500 ampères. The 100 HP. dynamo furnishes at present only 40 HP. to a centrifugal pump. Owing to the false indications given by ordinary ampère meters and voltmeters, the number of watts recorded is greater at Frankfort than at Lauffen.

Mr. B. H. Coffey submitted a paper embodying a theoretical discussion of the effect of centrifugal force on the transmitting power of driving ropes. The centrifical force counteracts the tendency of the tension to wedge the rope into the grooves, and thus lessens its frictional adhesion. Neglecting centrifugal force, we have, for the horse-power:

$$HP = V\left(\frac{D^2 + D - 1}{280}\right)$$

where V = velocity of rope in feet per minute,
and D = diameter of rope in inches.

But to allow for its action, the author deduces the formula:

$$HP = V\left(\frac{2{,}700\,A - WV^2}{11{,}180}\right);$$

where,

$A = (D^2 + D - 1)$,
V = velocity in feet per second,
W = weight in pounds of rope per foot.

Mr. Carl Hering discussed the papers of Messrs. Morris and Sellers, from the standpoint of a recent visit to the scene of the Lauffen-Frankfort transmission.

HOWARD MURPHY, Secretary.

American Railway Association.—The semi-annual meeting was held in New York Oct. 14. A report was submitted by the Committee on Safety Appliances, advocating co-operation on the part of the railways of the country in adopting measures which should insure safety to passengers. The subject of heating cars was broached, and the discussion which followed showed some diversity of opinion, although there was a unanimous sentiment in favor of some means that would be absolutely safe. The President, Col. S. H. Haines, delivered an address on "The Unit of Cost for Passenger and Freight Traffic." He pronounced the ordinary basis for obtaining the cost, by the average rate per ton per mile and the average rate per passenger per mile, to be absolutely valueless, and proposed in its place a division of accounts, based upon certain items in the cost of train service, the freight expenses being divided as follows: Class A—Expense directly affected by the amount of traffic; Class B—Expense indirectly affected by the amount of traffic; Class C—Expense incurred by car mileage; Class E—Expense incurred by the amount of freight loaded or unloaded. Mr. Willard H. Smith, chief of the department of transportation of the World's Columbian Exposition, addressed the association on the subject of securing exhibits for the Fair. The committee on train rules reported that up to date 106 companies, operating 75,000 miles of road, had adopted the standard code of rules, and 17 other roads, operating 6,947 miles of road, had agreed to work under the rules in future. A resolution was adopted expressing the interest of the association in the timber tests that are being conducted by the Department of Agriculture.

American Institute of Mining Engineers.—The sixtieth meeting of the institute was held at Glen Summit, Pa., last week, beginning Oct. 6, and was attended by about 125 members. We published last week two of the papers presented, and give in this issue two important papers on magnetic concentration, which gave rise to one of the most interesting and valuable discussions of the meeting, also the brief paper describing a novel method of hoisting water used in draining a coal mine.

A paper was read by Prof. Robert H. Richards, of the Mass. Inst. of Tech., describing a new attachment to hand telescopes for measuring distances on the stadia principle, measurements with a telescope magnifying 30 diameters have been made with an error of less than 0.1% for distances up to 800 ft.

Mr. H. F. Newell, of the U. S. Geological Survey, described the work in river gaging which is being done by that bureau in the far West. The Florence oil fields in Colorado were described by another worker in the U. S. Geological Survey, Mr. Geo. H. Eldridge.

A paper which called out a brisk discussion was read by Alfred E. Hunt on tests of structural iron and steel; and another important discussion was had at the closing session over the utilization of anthracite coal.

American Society of Civil Engineers.—The nominating committee has reported the following nominations: President, Mendes Cohen. Vice-Presidents for two years, Charles B. Brush, Samuel Whinery; for one year, Samuel M. Gray, John MacLeod. Directors for three years: L. L. Buck, W. P. Craighill, Desmond Fitzgerald, A. Gottlieb, Benj. M. Harrod, John Thomson; for two years: T. N. Ely, O. F. Nichols, Geo. W. McNulty, Robert Moore, P. Alex. Peterson, Robert L. Read; for one year: Chas. H. Myers, E. A. Fuertes, A. B. Hill, E. T. D. Myers, Jas. D. Schuyler, J. G. Van Horne. Secretary, Francis Collingwood. Treasurer, John Bogart.

American Society of Railway Superintendents.—At the annual meeting in New York this week, Mr. C. W. Bradley, of the West Shore R. R., was elected First Vice-President; Mr. G. B. Beach, Second Vice-President, and Mr. O. M. Shepard and Mr. E. G. Fleming, members of the executive committee for three years. The standing committees were reappointed, and Mr. W. G. Wilson and Mr. O. E. McClellan were added to the special committee on railway signaling.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

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D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST..... .....BUSINESS MANAGER

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COMING TECHNICAL MEETINGS.

Western Railway Club.—Oct. 20. Rooms, Rookery Building, Chicago.

Engineers' Society of Western Pennsylvania.—Oct. 20. Secy., J. H. Harlow, Pittsburg, Pa.

American Society of Civil Engineers.—Oct. 21. Secy., Francis Collingwood, 127 East 23d St., New York.

Engineers' Club of St. Louis.—Oct. 21. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.

American Street Railway Association.—Annual convention at Pittsburg, Pa., Oct. 21, 22, 23. Secy., Wm. J. Richardson, Brooklyn, N. Y.

Civil Engineers' Society of St. Paul.—Nov. 2. Secy., C. L. Annan.

Engineers' Club of Kansas City.—Nov. 2. Rooms, Baird Building. Secy., H. Goldmark.

Boston Society of Civil Engineers.—Nov. 4. Secy., S. E. Tinkham, City Hall.

Western Society of Engineers.—Nov. 4. Secy., J. W. Weston, 230 La Salle St., Chicago.

Engineers' Club of Minneapolis.—Nov. 5. Rooms, Public Library Bldg. Secy., F. W. Cappelen.

Association of Civil Engineers of Dallas.—Nov. 6. Secy., E. K. Smoot, 808 Commerce St.

Technical Society of the Pacific Coast.—Nov. 6. Secy., O. von Geldern, 819 Market St., San Francisco.

American Society of Swedish Engineers.—Nov. 7. At 250 Union St., Brooklyn, and 347 North 9th St., Philadelphia.

Northwest Railroad Club.—Nov. 7. Rooms, Union Station, St. Paul.

Atlanta Society of Civil Engineers.—Nov. 10. Secy., Parker N. Black, Room 39, Capitol Block.

Denver Society of Civil Engineers.—Nov. 10. Secy., Geo. H. Angell.

Northwestern Society of Engineers.—Nov. 10. Rooms, Occidental Block, Seattle. Secy., E. H. Warner.

Civil Engineers' Association of Kansas.—Nov. 11. Secy., J. C. Herring, Wichita, Kan.

New England Railroad Club.—Next meeting, Nov. 11, at United States Hotel, Boston. Secy., F. M. Curtis.

Civil Engineers' Club of Cleveland.—Nov. 13. Secy., A. H. Porter, 50 Euclid Ave.

Engineering Association of the Southwest.—Nov. 13. Secy., O. H. Landreth, Nashville, Tenn.

Northwestern Track and Bridge Association.—Nov. 18. Rooms, Union Station, St. Paul.

Engineers' Club of Cincinnati.—Nov. 19. Secy., J. F. Wilson.

New York Railroad Club.—Nov. 19. Rooms, Gilsey House.

Scandinavian Engineering Society of Chicago.—Nov. 19. Secy., T. G. Pihlfeldt, 118 Adams St.

Montana Society of Civil Engineers.—Nov. 21. Helena.

IN our editorial last week on the reports of the Rapid Transit Commission's engineers we stated, on the strength of information from a supposed authoritative source, that the Commission instructed Mr. WORTHEN to prepare plans for a railway having four tracks on one level and Mr. PARSONS to prepare plans for a double-deck system of construction. These gentlemen inform us, however, that the Commission has not attempted to control or hamper the work of its engineers even to this extent. Their instructions, as given in the resolutions adopted May 27, were, to make the necessary surveys and prepare in detail the plans and specifications for such a railway as the Commission outlined in those resolutions. By agreement between Messrs. WORTHEN and PARSONS, it was decided, with the approval of the Commission, that each should prepare plans independently of the other; and we understand that each presented the system which he considered best adapted to the circumstances and conditions presented.

We may note further in this connection that the Commission gave also large liberty of expression to its consulting engineers. Their letters of instructions asked: "Not only for approval or disapproval of the plans submitted, but for such general discussion and such suggestions as to alterations or additions as might in your judgment be regarded as necessary or desirable to accomplish in the best manner possible the objects sought to be obtained, upon the route and general plans outlined in the resolutions of the Commission dated May 27 and July 22, 1891."

THE magnetic concentration of iron ore is a process whose possibilities and promise are hardly appreciated by engineers in general. It is a simple process in principle. The low grade iron ore, crushed to a suitable degree of fineness, is passed over electro-magnets, which attract and hold the particles of iron, but permit the particles containing no iron, which includes a large part of the injurious impurities, to pass on to the waste dump. But though the principles involved are so simple, the working out of the details of the process and the development of practical and commercially successful processes of magnetic concentration has required a high degree of electrical, metallurgical and mechanical skill.

Elsewhere in this issue we publish three important papers referring to this process. One by Mr. W. H. HOFFMAN describes the remarkable perfection which has been reached in operating this process at the Croton, N. Y., mines, where an ore averaging about 40% of iron, 0.23% of phosphorus and 2% of sulphur, is yielding a concentrate which averages 68% iron, 0.44% sulphur, and 0.036% phosphorus, with a tailings product containing but 7% to 8% of iron. This is done at a total cost, including mining, crushing, roasting, screening, concentrating, delivery on board cars, interest, taxes and repairs, of only $1.95 per ton of concentrates. The most surprising fact is that the cost of the magnetic concentration is a very insignificant part of the total, being only 7 cts. per ton of concentrates produced. The main items of cost are mining, roasting and crushing the ore; and the above figures show that these operations have been very well worked out at the Croton mines.

These results have been attained, says Mr. HOFFMAN, not in experimental working, but in regular commercial practice, extending over a period of 18 months, with an output of from 50 tons to 220 tons per day, all of which has been sold at a profit.

THIS last statement is one of the most important in connection with the success or failure of magnetic concentration. Suppose these concentrates can be produced of great purity and at low cost, can they be successfully used in the blast furnace? Besides the answer to this question which is furnished by the commercial experience of the Croton mine managers, we have the brief but interesting paper of Mr. LANGDON, reporting about two years' experience with magnetic concentrates, in the Port Henry blast furnaces, from which he concludes that there is no difficulty in using at least 80 per cent. of concentrate for the blast furnace charge, and that there is an actual economy of fuel by the use of large proportions of concentrate. The practical value of concentrates as fine even as 60-mesh is attested by Mr. E. S. MOFFATT, of Scranton, who has used 8,000 tons of varying degrees of fineness in the Lackawanna furnaces.

The third paper is one presented at the Cleveland meeting of the Institute, in which the use of magnetic concentrates in a modification of the open hearth process is described. While the results here obtained were merely experimental, they were, on the whole, satisfactory: and taken in connection with European experience they indicate that large quantities of high grade concentrates may yet be profitably smelted in the open hearth furnace, producing an excellent grade of steel at very moderate cost. It is to be noted that this process will probably be especially adapted to utilize the very fine concentrates whose availability for blast furnace work is still questioned by some engineers.

OF course it is true that the limits to the commercial working of magnetic concentration are still to be determined. More experience is needed before it can be predicted with confidence just how poor an ore can be profitably treated, and the location of the mine and physical character of the ore are also vital factors in the problem. Mr. HOFFMAN believes that an ore with only 22% of iron can be concentrated at Croton mines at a profit; and Mr. T. A. EDISON and his associates are spending an enormous amount on a concentrating plant at Ogden, N. J., to handle a 16% ore. As already stated, the cost of mining and crushing forms a large proportion of the cost of the finished concentrates. But the low grade ores to be treated occur in such masses that they will generally be excavated in open quarry; and modern rock drills, explosives, and hoisting and carrying plant have vastly cheapened this mode of operation.

The demand for concentrates is likely to increase as their excellence and reliability for blast furnace work or for some of the direct processes of steel manufacture is better realized. At the same time improvements in crushing and grinding machinery, which is the most difficult portion of the problem mechanically, are pretty certain to be made.

It may safely be concluded, therefore, that magnetic concentration is destined to play no unimportant part in the future of iron mining and manufacture. It has been predicted that its introduction would restore much of the old time prestige of the magnetite beds of low grade ore of New York and New Jersey. In general, as low grade ores are far more widely scattered than pure and high grade ores, it seems likely to facilitate the development of iron mining in States where little or nothing in that direction has been done. Commercially, it may bring an effective and widespread competition to bear on the producers of Bessemer ore; and it may even enable furnaces in the North to compete with the cheap coal and ore which for a year or two past have seemed to be giving the furnaces of Alabama and Tennessee an advantage in the race of competition too great to be overcome.

The development of new fields of iron ore production will have a marked effect on railway traffic in many quarters, and will doubtless lead to considerable new construction. Indeed, we believe Mr. EDISON is already at work on a branch line to one of the mines which he has purchased.

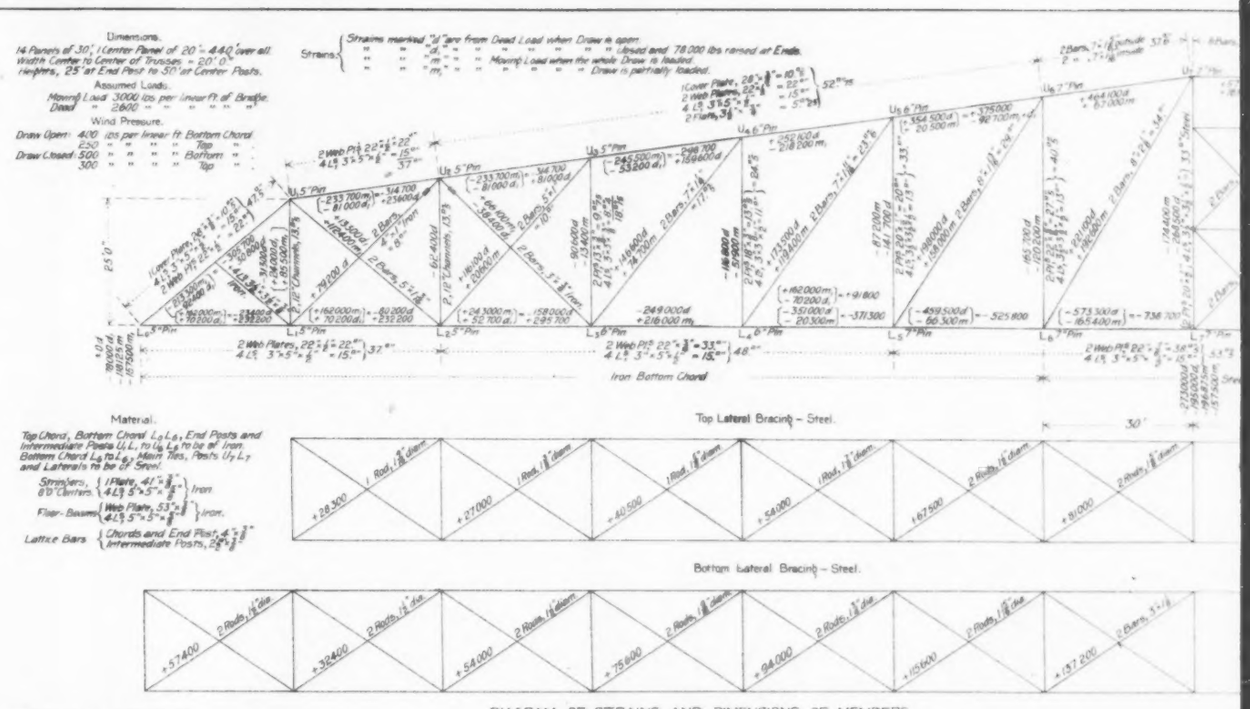
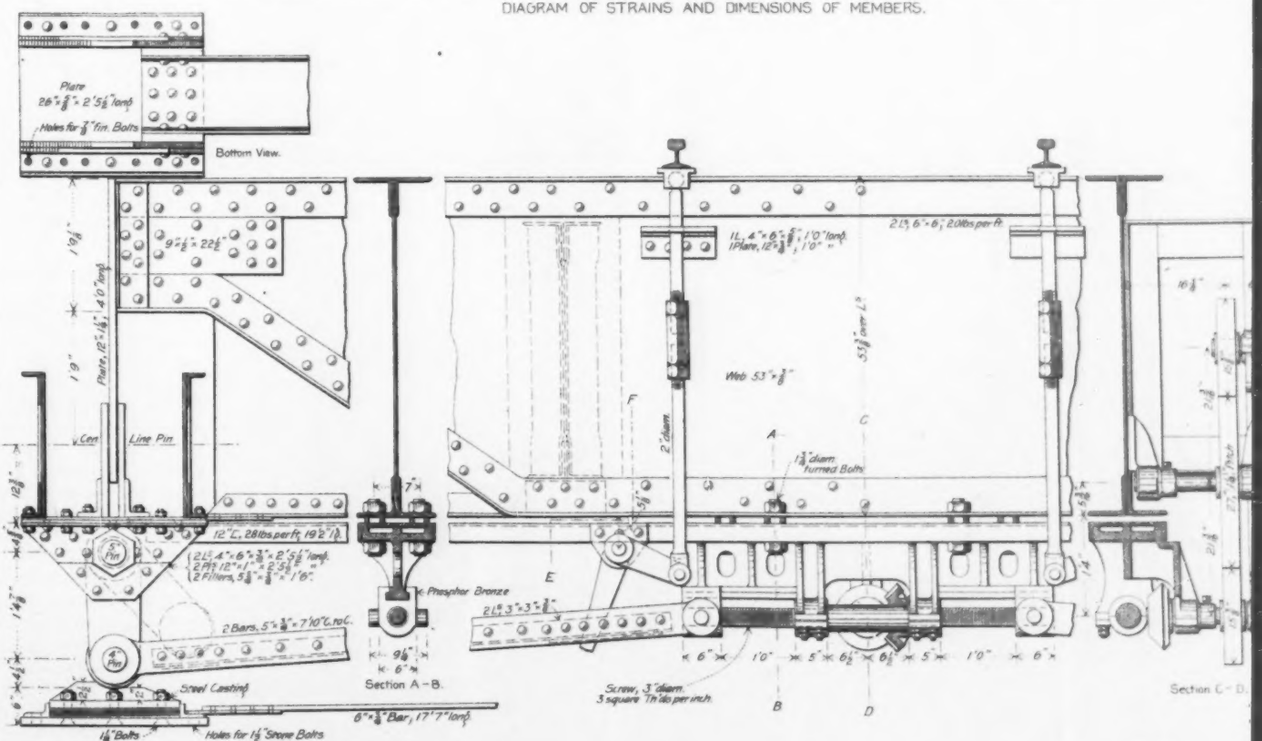

Dimensions.
14 Panels of 30', 1 Center Panel of 20' = 440' over all.
Width Center to Center of Trusses = 20' 0"
Heights, 25' at End Post to 50' at Center Posts.
Assumed Loads.
Moving Load 3000 lbs. per linear ft. of Bridge.
Dead " 2600 " " " " "
Wind Pressure.
Draw Open: 400 lbs. per linear ft. Bottom Chord
250 " " " " Top "
Draw Closed: 500 " " " " Bottom "
300 " " " " Top "
Strains.
Iron Bottom Chord
Material.
Top Chord, Bottom Chord L0L1, L4L5, End Posts and Intermediate Posts U1L1 to U4L4 to be of Iron.
Bottom Chord L1L2 to L3L4, Main Ties, Posts U5L5 and Laterals to be of Steel.
Top Lateral Bracing – Steel.
Bottom Lateral Bracing – Steel.

DIAGRAM OF STRAINS AND DIMENSIONS OF MEMBERS.



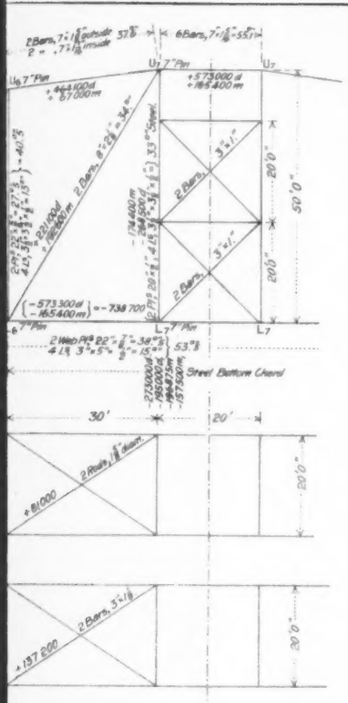
DETAILS OF END LIFT.

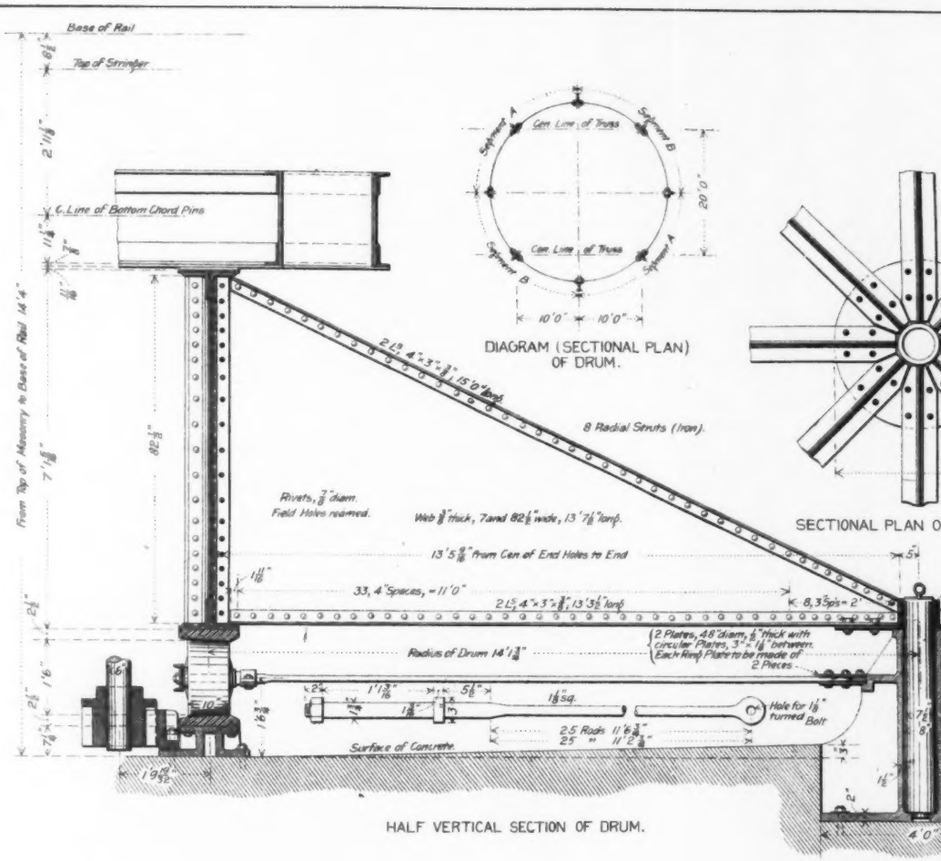
SWING

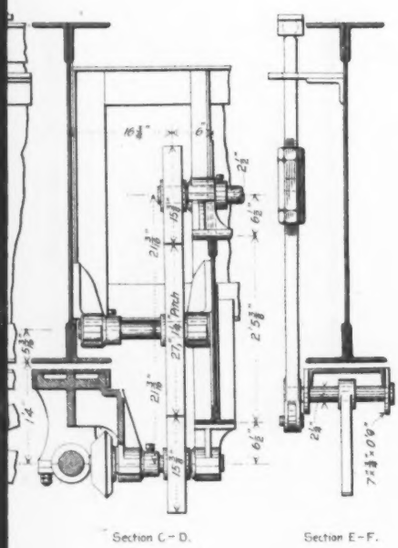
WINONA BRIDGE

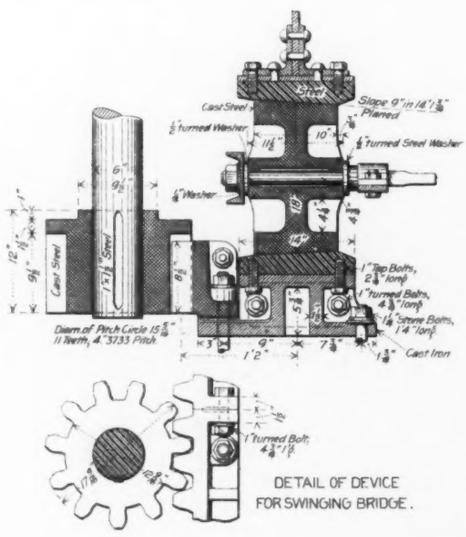
GEORGE S. MORISON, CONSU

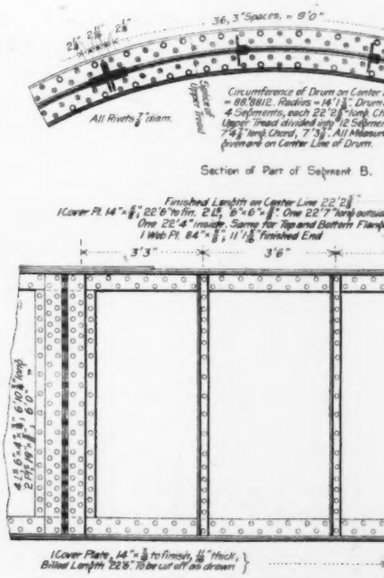
THOS. J. LONG, ENG




Base of Rail
Top of Stringer
C. Line of Bottom Chord Pins
From Top of Masonry to Base of Rail 14'4"
8 Radial Struts (Iron).
Rivets, 7/8" diam. Field Holes reamed.
Web 3/8" thick, 7 and 82 1/2" wide, 13'7 1/2" long.
13'5 5/16" from Cen. of End Holes to End
33, 4" Spaces, = 11'0"
Radius of Drum 14'1 1/4"
Hole for 1 1/8" turned Bolt
Surface of Concrete
Cen. Line of Truss
Segment A
Segment B
10'0"
DIAGRAM (SECTIONAL PLAN) OF DRUM.
SECTIONAL PLAN O
HALF VERTICAL SECTION OF DRUM.




Cast Steel
Slope 9" in 14'1 5/8" Planed
1/2" turned Washer
1/4" turned Steel Washer
1/4" Washer
1" Top Bolts, 2 1/2" long
1" turned Bolts, 4 1/2" long
1/4" Store Bolts, 1/4" long
Diam. of Pitch Circle 15 5/8"
11 Teeth, 4.3733 Pitch
Cast Iron
1" turned Bolt, 4 1/2" long
DETAIL OF DEVICE FOR SWINGING BRIDGE.



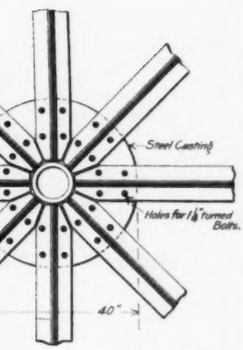
SWING SPAN OF THE WINONA BRIDGE,

INONA BRIDGE RY., OVER MISSISSIPPI RIVER, AT WINONA, MINN.

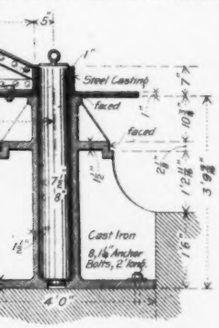
RGE S. MORISON, CONSULTING ENGINEER. D. M. WHEELER, CHIEF ENGINEER, WINONA BRIDGE RY.

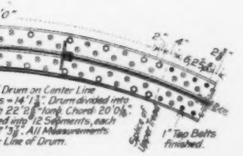
THOS. J. LONG, ENGINEER FOR UNION BRIDGE CO. UNION BRIDGE CO., CONTRACTORS.

CHAS. HAR

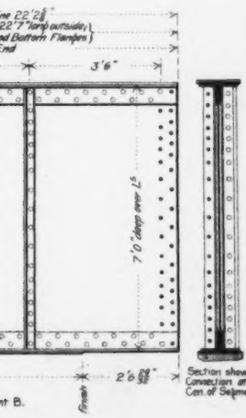


AL PLAN OF CENTER OF DRUM.





Segment B.



t B.

F DRUM.

CHAS. HART & SONS, LITH. 36 VESEY ST., N. Y.

Altogether the results of this new departure in the iron mining industry will be watched with much interest.

THE row over the office of City Engineer of Toronto, which has resulted in the resignation of Mr. JENNINGS, the late incumbent, had for its origin a lack of aldermanic wisdom that is interesting to other communities, and especially to engineers. Mr. JENNINGS contended that the terms of his appointment, about one year ago, gave him the right to raise the salaries of some of his assistants; and he did this in the interest of the city and for the purpose of retaining the services of a tried and good man. The aldermen denied this right and insisted upon regulating salaries to suit themselves, and have apparently so altered the law as to deprive Mr. JENNINGS of the future exercise of this privilege. Hence the disagreement; though Mr. JENNINGS has finally consented to remain in office until Jan. 1, 1892.

THE question at issue is, Who is to decide upon the fitness for office and the value of services of an engineer—the city engineer, who is responsible for the work performed and is in a position to exactly determine these points, or an average board of aldermen, who know nothing of the duties of the office or the requirements in the man to fill that office? Within certain limits, which can be well left to any competent city engineer to fix for himself, there can be no doubt as to which is the proper, safe and economic course to pursue. In our opinion, the whole duty of the City Council or Board of Aldermen ends in securing the services of as competent a city engineer as the importance of the city and work involved demands. In the true interest of the city that they are, at least, supposed to represent, it is their duty to obtain the best man possible and to pay him the salary that ability, training and long experience in this special class of work should and usually do command. He should be held strictly accountable for the character and amount of work to be performed by himself and his assistants. But he can only do this when he has full power of appointment and discharge over his staff, and can pay such salary as he thinks his assistants are really worth to the city.

CHEAP engineers can always be found, unhappily; and in a false spirit of economy in dealing with matters where true values are rarely appreciated, owing to utter ignorance of requirements, the city authorities will usually select the cheapest man. But by so doing they not only hamper a responsible man with irresponsible assistants, but they openly bid for bad work in public improvements, and make themselves liable for a hundredfold the money saved in salaries in undoing this bad work. It is a business principle that a good man is worth a good salary, and an incompetent man is dear at any price. This principle applies quite as well to cities as it does to private corporations; and as someone must measure the value of the services of assistant city engineers, there is no one man, or body of men, so competent to do this as the City Engineer, who employs them and is in a position to judge of their ability and true worth. We would add, however, that as this official can not have unlimited power in the financial affairs of a city, he should submit to the municipal authorities his estimate of the amount of money he thinks the importance of the engineering work demands. But the disposal of this amount should be left to him, to apportion as he deems best for the interests of his work, and as the merits of individual members of his staff may warrant. While comparatively few communities seem yet to appreciate the fact, it pays roundly to be liberal with the men who often have in charge the execution of millions of dollars' worth of public work. For upon the ability, experience and hearty co-operation of these men depend the proper planning, the economic conduct and ultimate cost of structures where the unnecessary expenditures of one month might more than amount to a year's salary of competent men.

ONE of the surprises which await the untraveled American abroad is the all but universal use of "double deck" omnibuses and street cars, the roof seats about doubling the seating capacity, whereas in this country such seats are still the rare exception even in street cars and are all but unknown on omnibuses. A principal reason for the contrast is no doubt this, that throughout benighted Europe public vehicles are not permitted to carry more passengers than they can seat, whereas in our own more enlightened country no tramway line attempts to furnish every passenger even with a strap to hang on to, but feels that it has done its whole duty (as it has if the people will submit to it) when it provides bare standing room; and when even a single deck is packed like a sardine box about as many passengers are carried as the horses can haul. Another reason for the contrast is perhaps the superior condition of the European streets. As the expense of providing these deck seats is very small, however, and as the deck seats are taken from choice by most passengers for at least half the year, it is a public misfortune that most of our street conveyances are not so equipped.

The rapid introduction of electric street railways gives promise that this may soon come about, for the simple reason that the available power per car not being limited, the upper deck means so much additional earning capacity to the electric car, although not to the horse car. A very fine new car of this kind was tested at Pullman, Ill., last week, as noted in our news columns, and we cannot but think that it is the forerunner of extensive equipments of that general type. And when the electric railways have done this the horse cars may be driven to use them by the effect of example, especially as the earning capacity of any car is thereby somewhat increased.

WE notice in a recent "Circular of Information" as to the engineering courses of the University of Wisconsin a feature which is deserving of special mention, and which we cannot doubt will prove of special advantage, to wit: Instead of giving the ordinary mere list of professors, it gives for each professor, separately, his professional record in much the same form as is required for applications for admission to large engineering societies, the record covering the place and date of birth and of graduation, and "a concise but complete account, with dates, of the whole of his professional career." Thus the quality as well as quantity of the tuition offered can be measured with greater precision than is possible from the usual bare list. It is but just that we should add that the University of Wisconsin appears to be exceptionally well provided in this respect, every one of its six professors of engineering and mechanical practice having had from two to thirteen years of practical experience before assuming the duties of a professorship.

We can conceive of no practice which would more powerfully tend to improve the quality of the instruction offered in engineering schools than this of publishing the "record" of each professor of applied science in the college catalogues. It would check what is an undoubted evil in present tendencies—that of developing professors of engineering from graduates and tutors direct, without the intervention of any considerable amount of practical experience. Not but that many able men have been and are obtained in this way: in many cases, beyond doubt, better instructors than could have been otherwise obtained. We would by no means advocate any cast iron rule on the subject, but we do think that there should be some stronger inducement than now exists for giving a decided preference to men of a certain age and experience when appointing professors, for we fully believe that much more is gained by such experience than is lost in familiarity with books and collegiate routine. If the custom which has been thus inaugurated once became general, an engineering school would have a strong inducement to search for men of some considerable professional experience as professors, and hence would be more ready to offer the greater inducements which such men generally require.

Hours of Labor of English Railway Servants.

In February of this year a committee of the House of Commons was appointed in England to investigate and report whether any restrictive legislation was required in regard to the hours of railway servants, and, if so, what. The committee was granted full powers, and has collected full reports as to the hours of labor on every railway in the kingdom, in the month of December, 1890, which lie before us in two large blue-books. The committee has contented itself for the present session with submitting these facts without other comment than to recommend the appointment of a new committee on the same subject at the next session, declaring that it is not yet prepared to express any final opinions.

The two volumes differ from each other only in this: One of them gives the cases of excess over a 10-hour day, and the other over a 12-hour day. They are otherwise identical. The full title of each volume is:

"Return of Certain Classes of Weekly-paid Servants who were on one or more occasions during the month of December, 1890, on Duty on the Railways of the United Kingdom for more than Ten [or Twelve] Hours at a time; or who, after being on Duty more than Ten [or Twelve] Hours were allowed to resume work with less than Eight Hours' Rest."

In each of these volumes the returns are separately given for every railway in the United Kingdom for six different classes of employees separately, viz.: passenger trainmen, passenger enginemen, freight trainmen, freight enginemen, signalmen and "examiners." This necessarily requires a vast mass of figures, from which it is exceedingly difficult to draw any definite conclusions, especially as no attempt is made to classify or tabulate the returns so as to make the deduction of conclusions from them easy.

To show in small compass the substance of what these returns indicate we have selected at random 7 of the largest companies, and abstracted their returns of *percentages* for 5 different classes of employees in such manner as to show how many out of 100 of each class of employees are on an average working 11, 12, 13, 14, 15, 16, 17 or 18 hours per day. We have neglected the returns in regard to intervals of rest less than 8 hours. The 7 companies whose records we have tabulated are: London & Northwestern, London & Southwestern, London, Brighton & South Coast, London, Chatham & Dover, Manchester, Sheffield & Lincolnshire, Midland, and Southeastern.

These companies employ in the aggregate 15,402 enginemen and firemen, which is a little over half the probable number now in service in the United Kingdom, if we may estimate the latter as somewhat less than 30,000 in December, 1890. There are 6 other large companies which employ 1,500 or more enginemen and firemen, viz., the Lancashire & Yorkshire, North British, Caledonian, Great Western, Great Northern and Great Eastern. These companies employ in the aggregate 5,808 enginemen and firemen. As nearly as we can judge, the records for these 6 companies do not differ in substance from those of the 7 companies which we chanced to select, so that the following table may be considered to fairly represent the present hours

of service in Great Britain of the classes of employees tabulated.

AVERAGE DAILY PERCENTAGE OF VARIOUS CLASSES OF EMPLOYEES ON VARIOUS ENGLISH RAILWAYS WHO WERE EMPLOYED FOR VARIOUS HOURS OF SERVICE IN EXCESS OF TEN (10) HOURS, IN DECEMBER, 1890.

PASSENGER GUARDS AND BRAKEMEN.

	11 h'rs.	12 h'rs.	13 h'rs.	14 h'rs.	15 h'rs.	16 h'rs.	17 h'rs.	18 h'rs.
L. & N. W....	19.88	14.25	5.59	1.40	10.50	0.14	0.04	0.05
L. & S. W....	11.63	11.73	11.60	0.69	3.23	1.63	0.31	0.13
L. B. & S. C.	17.58	16.02	10.08	0.52	2.14	1.03	0.46	0.20
L. C. & D....	11.12	18.92	10.57	5.09	5.09	2.62	2.01	0.60
M. S. & L....	14.59	11.58	10.21	6.89	2.78	0.50	0.02	..
Midland	10.47	18 12	12.59	6.12	5.67	0.63	0.33	0.18
S. E	12.36	14.65	8.40	4.90	1.98	1.28	0.51	0.81
Arith. mean	13 37	15.04	9.86	5.80	3.00	1.14	0.53	0.28

PASSENGER ENGINE CREWS.

L. & N. W....	8 77	11.65	12.73	9.47	3.09	0.35	0.18	0.04
L. & S. W....	12.15	9 64	6.36	5.36	2.90	2 07	0.91	0.63
L. B. & S. C	6.62	8.71	9 17	9.04	6.31	2.62	1.44	1.72
L. C. & D....	12.21	15.81	4.89	3.56	2.07	1.03	0.55	0.53
M. S. & L....	11.58	10 89	7 11	10.08	10.22	3.38	0.83	1.09
Midland	11.19	12.03	12.67	8.56	3.84	1.27	2.74	3.79
S. E	8.49	9 92	7.68	7.91	8.42	4.77	3.19	3.23
Arith. mean	10.14	11.36	8.65	7.71	5.26	2.21	1.41	1.57

FREIGHT GUARDS AND BRAKEMEN.

L. & N. W....	20.32	14.10	2.47	0.38	0.12	0.03	0 03	0.01
L. & S. W....	9.50	12.36	10.27	6.29	2.89	2.48	1.55	2.71
L. B & S. C...	6.89	9.42	10.40	10.51	9.93	7.88	4.34	8.82
L. C. & D	3.50	8 17	9.61	9.54	5.15	7.07	5.15	11.40
M. S. & L.....	7.75	19.75	13.02	11.14	9.29	4.91	2.59	3.17
Midland	10.18	14.74	11.47	9.23	6.84	4.33	2.74	3.79
S. E	10 54	13.73	11.15	8.30	7.36	4.40	3.34	5.66
Arith. mean	9.81	13.18	9.77	7 96	5.91	4.44	2.82	5.08

FREIGHT ENGINE CREWS.

L. & N. W....	8.05	12.20	12.33	9.82	4 55	0.35	0.16	0.08
L. & S. W....	6.80	13.82	11.74	9.98	7.09	4.27	1 62	1.10
L. B. & S. C..	4.41	6.53	7.32	8.70	8.19	7.94	6. 8	9.45
L. C & D....	4.63	7.55	5.18	8.62	5.60	5.66	4 09	7.28
M. S. & L....	5.08	18.55	10.86	10.95	8.79	6.29	3.41	4.09
Midland	7.50	17.74	11.47	10.02	7.55	5.31	3.34	3 47
S. E	6.06	9.28	9.25	9.13	9.11	7.21	5.85	12.13
Arith. mean	6 08	12.24	9.88	9.60	7.21	5.29	3 54	5.37

SIGNALMEN.

L. & N. W....	6.01	43.73	0.21	0.14	0.06	0 04	0.01	0.01
L. & S. W....	7.31	27.49	3.81	2.17	0.61	0.09	0.06	0.11
L. B. & S. C..	6.28	38.01	1.26	0.65	0 29	0.03	0.02	0.02
L. C. & D....	24.48	11.04	14.75	2.56	0.43	0.25	0.04	0.11
M. S. & L....	2.19	63.84	2.68	0.77	0.23	0.16	0 08	0 04
Midland	20.35	7.08	1.30	1.23	0.50	0.25	0.07	0.06
S. E	12.66	20 27	7.16	2.39	0.74	0.41	0.20	0.19
Arith. mean	11.41	33.07	4.47	1.42	0.41	0.18	0.07	0.08

The table appears to reveal a state of things in regard to hours of labor which is quite without parallel in this country and which is well worth study. Contrary to the general rule in this country, the engine crews, both freight and passenger, work longer hours than the train crews, and the freight crews, as is natural, work longer hours than the passenger crews, though there is not so much difference between them as one would expect or as exists in this country. We need hardly say that in this country an engine crew is considered to have done a day's work whenever it has run from 100 to 120 miles, and consequently the normal passenger day's work is from 4 to 6 or 7 hours only, including time lost at terminals, while the freight crew's day's work may lengthen out to 10, 12 or 15 hours. In times of pressure much more than six days' time per week is very often made, but as a rule the staff is so organized as to require about that amount of work from each employee in ordinary working. In England the accompanying large table shows the following to be the customary hours for the freight and passenger engine crews in the month of December, 1890:

Mean daily per cent. of engine crews working:	Freight crews.	Pass'r crews.
Eleven hours daily or more	59.21	48.31
Twelve " " "	53.13	38.17
Thirteen " " "	40.89	26 81
Fourteen " " "	31.01	18.16
Fifteen " " "	21.41	10.45
Sixteen " " "	14.20	5.19
Seventeen " " "	8.91	2.98
Eighteen " " "	5.37	1.57
Average hours per day of entire force	12.34	11.52

It will be seen that more than half the freight engine crews work 12 hours or more; nearly a third work 14 hours, more than a fifth work 15 hours, a full seventh work 16 hours, one man in 11 works 17 hours, and one man in 20, 18 hours, as an average of the entire month. In the passenger service the hours of the engine crews are not so long, but yet, when speed is considered, are much longer in proportion. Nearly half average 11 hours, more than a third 12 hours, more than a quarter 13 hours, nearly one-fifth 14 hours, more than one-tenth 15 hours, and more than one-twentieth 16 hours, while one man in 63 works 18 hours at a stretch in running passenger engines, as an average of the entire month.

These hours, it will hardly be disputed, are far too long, and the only wonder is that they do not result in accident more frequently than they do. The English accident records sufficiently prove, however, that they do not result in any great increase in accidents, but that they involve some increase of risk and are oppressive to the men, goes without saying. They are nearly or quite as bad as the excessive hours which formerly prevailed in American horse car service, and considering the more exacting nature of the duty, they are even more oppressive. We have computed from the records the average hours of duty of the entire force, which will be seen to be 12¼ hours for freight service and 11¼ hours for passenger service. These averages in themselves do not seem so very excessive, but it is to be remembered in considering them (1) that there is a good deal of lost time going to and from work which is not counted, and (2) above all, the irregularity of the service, as indicated by the above figures. It is far more exhausting to be called on every third day to work 14 to 16 hours continuously, working only 10 hours between times, than to work 12 hours per day regularly.

The train crews, as we have stated, do not work quite so many hours as the engine crews, though the difference is trifling and without much significance. The train crew record may be abstracted from our large table as follows:

Mean daily per cent. of train crews working:	Freight crews.	Pass'r crews.
Eleven hours daily or more	58.99	49.08
Twelve " "	49.19	35 71
Thirteen " "	36.01	20.67
Fourteen " "	26.24	10.81
Fifteen " "	18.28	5.01
Sixteen " "	12.34	1 95
Seventeen " "	7.90	0.81
Eighteen " "	5.08	0.28
Average hours per day of entire force	12.14	11.24

It is hardly necessary to summarize this record as we have done above, it is so nearly identical with the engine crew record.

The signalmen, naturally, have easier hours than the trainmen, but their hours also are at times pretty severe, as will be seen from the following record:

Mean daily per cent. of signalmen working:	
Eleven hours daily or more	51.09
Twelve " " "	39.68
Thirteen " " "	6 61
Fourteen " " "	2.14
Fifteen " " "	0.72
Sixteen " " "	0.31
Seventeen " " "	0.15
Eighteen " " "	0.08
Average hours per day	11.01

It would appear from this record that it is the rule for signalmen to work 12 hours per day (the average being pulled down to one hour less than this by the extra hands employed during rush hours), and that they are freely called on for extra service up to 13 or 14 hours daily, but rarely for more than this. Still, about once a year, the signalman is likely to be called on for 16 hours continuous duty, and about once in three years for 18 hours duty.

The fluctuations of the individual roads from these averages can be deduced from our large table by anyone interested, but are hardly of enough interest in this country to make it worth while for us to do so. They are not very great, and hence the arithmetical means given may be considered as fairly representing the present average of English practice, from which there are no material deviations. We may note, however, that on the Metropolitan and Metropolitan District railways (corresponding in class of service to our New York elevated lines), but few of the trainmen and none of the signalmen are on duty more than 10 hours. This concession appears to be made to the nature of the service.

On the New York elevated lines, however, this is regulated much more strictly yet, and much more to the advantage of the men. The day's duty is *precisely* 9 hours for the engine crews, and 10 hours for the train crews, from the time of reporting for duty to the time of going off. To this end the men go on and off duty not merely at terminal points but at several intermediate points on the 8-mile run. At the station where a man's 9 or 10 hours of service expires he finds a man waiting to relieve him, and steps down and off. Correspondingly, when it comes his turn to go on duty, he has to use his own time to report at such station as may be fixed by the schedule for his going on duty. Of course an effort is made to effect this change at terminals so far as possible, and the system gives entire satisfaction both to the men and the company.

THE BROOKLYN RELIEF SEWER, mainly on Greene Ave., Brooklyn, is about 9,000 ft. in total length and 12, 14 and 15 ft. in diameter, lined with 16 ins. of brickwork. It is tunneled on the Anderson pilot system through dry sand, gravel and boulders. The progress last month, working from six headings, was a little over 1,000 ft.; and last week the progress was 262 ft. The contractors are Messrs. ANDERSON & BARR.

A GRAVITY WATER SUPPLY FOR PHILADELPHIA has been recommended by Director WINDRIM. It is proposed to impound the waters of the Perkiomen and Tohickon creeks, and provide a storage capacity of 25,000,000,000 galls. at an elevation of about 300 ft. above city datum. The estimated cost of the project is $16,000,000. Director WINDRIM has also asked for increased pumping and storage in connection with the present works.

HYDROGRAPHIC SURVEYS AND CHARTS OF THE GREAT LAKES are to be soon commenced by the Government. The hydrographic bureau has practically done nothing for these lakes owing to the treaty which prohibits a naval establishment on the lakes and the consequent lack of interest of the navy department in lake navigation. The importance of the present lake commerce makes it very desirable to have reliable charts showing the currents, shoals and wrecks.

THE NIAGARA WATER-POWER TUNNEL was commenced on Oct. 4, 1890. On Oct. 1 of the present year the progress stood as follows:

Open cut at portal	170 lin. ft.
Portal tunnel	668 "
No. 1 shaft—West	263 "
" " East	270 "
No. 2 shaft—West	572 "
" " East	545 "
Total	2,518 lin. ft.

From Sept. 19 to Oct., 1 331 ft. were driven from five headings.

A NEW DOUBLE-DECK HORSE CAR, propelled by a Westinghouse motor supplied with current through a trolley, was successfully tested at Pullman, Ill., last week under the auspices of Mr. GEO. M. PULLMAN. It is 32 ft. × 7 ft. 4 ins. × 14 ft. 9½ ins. in extreme dimensions and seats 40 passengers on each deck. Passengers enter at the center, and ascend to the upper deck by spiral stairways. The lower deck consists of two compartments with semicircular ends around which the seats are carried in lieu of end platforms. Electric bells, electric lights and even an "electric heater" (which last is hardly likely to be used much in practice) are provided, as also an "electric diagram" to indicate to the lower deck what seats are vacant on the upper deck. The car weighs 28,000 lbs. and cost $3,500.

CORRESPONDENCE.

The Alessandro Irrigation District, California.

MORENO, Cal., Sept. 7, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Referring to the article in your issue of Aug. 29, 1891, on "Irrigation and Irrigation Districts in San Bernardino Co., Cal.," I beg leave to correct some of the statements pertaining to the Alessandro Irrigation District, and to give some further information in a general way regarding its water rights and distribution system, as I have been engineer of the district since its formation, also the designing and constructing engineer for the system of distribution of the waters over the lands owned by the Bear Valley Irrigation Co. in this district.

The Alessandro Irrigation District embraces some 25,500 acres of choice agricultural land in the so-called "San Jacinto Valley," and is about 10 miles from Riverside and Redlands. The tract has a wide range of elevation from 1,450 to 2,000 ft. above sea level, although the average elevation is from 1,600 to 1,800 ft. Some 14,000 acres of land in this district have been surveyed and subdivided into 80-acre blocks, containing 8 equal lots, with avenues running east and west 80 ft. in width, and running north and south 60 ft. in width, allowing ample space for the planting of shade trees along the borders. Some 9,400 acres have been sold to bona fide purchasers, and upward of 2,500 acres have been planted to citrus and deciduous fruit trees, about 50% of each.

In April, 1891, the first water from the Bear Valley Irrigation Co.'s system was delivered to the district from the main pipe line of the former, which connects with Tunnel No. 1, some 2,329 ft. in length, to the main canal at an elevation of 2,038 ft. above sea level, and thence by the canal about one-half mile in length to a distributing reservoir, from which the mains carry the water over the district.

A branch steel pipe supplies the flourishing town of Moreno, located at an elevation of about 1,600 ft., giving a pressure of over 200 ft. for domestic and irrigating purposes in the townsite. Since June 1, 1891, water for irrigating purposes has been delivered to all the lands under cultivation on schedule time, and under the control and management of the board of directors, who employ three zanjeros for handling the water.

The average daily flow is about 400 ins., or 8 cu. ft., per second. The system of distribution is so planned that the mains over the tract are steel pipes under pressure, while the laterals form a gravity system of salt glazed vitrified clay pipes, with outlets and measuring weirs at the highest corner of each 10-acre tract, the entire lateral system having a minimum capacity of delivering to each 10-acre tract a 20-in. head of water every 16 days, and in many cases a much larger capacity, this being ample for the irrigation of small fruits, for which the soil seems equally as well adapted as to the successful growth of the citrus fruits.

The main pipes have been laid by contract and the laterals by day's labor, using the best materials obtainable; upward of 70 miles of pipe have been completed to date, and the work is being pushed rapidly.

The district has issued bonds in the sum of $765,000, at the rate of $30 per acre, which have been sold to the Bear Valley Irrigation Co. at par for a permanent water right to the entire district, on a basis of 1 in. under 4-in. pressure for every four acres of land, making the total water right 6,375 ins., or 127.5 cu. ft., per second, delivered according to contract, a sufficient amount each year for all lands under cultivation. The water right is made pertinent to the lands in the district, and cannot under any circumstances be transferred or sold for any lands outside of the boundaries of the district.

The system of lateral pipes for the distribution of the water, and the use and control of the mains for carrying the said water, will be transferred to the Alessandro Irrigation District by deed, to be owned and controlled by them through their board of directors, so that the individual purchaser of land of the Bear Valley Irrigation Co. in this district acquires absolute title to his land, a perpetual water right, and the system necessary to deliver said water to the highest corner of each and every 10-acre tract in a pipe, and when using his full quota of water pays a rental of $5.56 per acre.

The rental system has many advantages which I have not time to discuss in this article.

It is safe to say that the Alessandro Irrigation District has the largest and most permanent supply of water and the most complete and economical distribution system of any district in California. Lands are now selling readily at $110 per acre, and the marked improvements both in substantial buildings and in the planting of young orchards and vineyards, show the rapid but solid growth of this district. A detailed report and estimate of the cost of the entire system, with descriptions and illustrations, is now being perpared, and will be published as soon as completed.

JAS. T. TAYLOR,
Engineer Alessandro Irrigation District.

[As stated in connection with the article referred to above, some of the facts given were applicable last February only. Therefore Mr. TAYLOR'S "corrections" rather take the nature of later details. Mr. TAYLOR'S position as engineer for the district enables him to speak with authority, and we are, therefore, pleased to give space to his later and more extended description of the district.—ED. ENG. NEWS.

The Laying Out of Towns.

SPRINGFIELD, O., Sept. 29, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: This subject is one which deserves attention. In former eras of the world a different mode of life and other conditions caused the adoption of the principle of centralization where the values of real estate increase toward a fixed center. This system is of monarchic origin, and is unsuited to these times. The era of cheap and rapid transit and republican institutions is more suited to extension than to centralization of values. Towns laid out under this principle should have large areas of land left unoccupied for parks and other purposes, and exigencies that may arise in the future. The cultivation of a taste for horticulture and gardening will also demand large lots, laid out on the avenues from the town far into the adjoining country. Space between the buildings and larger areas for every purpose will also be necessary. Instead of confining the limits of a town to one square mile, under the operation of the principle of extension it will cover an area of 10 square miles. That this should be the future result of the building of street railways seems, at least, to be very probable. WILLIAM CLAYPOOLE.

Joint for Trestle Work.

HARRIMAN, Tenn., Oct. 6, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I see in the number of Oct. 3 a communication with regard to trestle post joint from Mr. EMILE LOW who evidently misapprehends the drawing of mine. Our joints have in a 12 × 12 in. post 144 sq. ins. of bearing surface against each other, while if I mistake not, the Norfolk & Western post has only 72 sq. ins. in the same sized post; in my opinion a very marked difference.

J. P. SUVERKROP.

Tests of Iron Columns.

NASHUA, N. H., Oct. 4, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In answer to your correspondent on pp. 369-376, in Gaetano Lanza's "Applied Mathematics," edition 1890, will be found a description of tests made upon full-sized cast iron columns at the Watertown Arsenal.

W. W. L.

Notes and Queries.

In reply to the query of B. F. La R. concerning published experiments on cast-iron columns, Mr. GUS C. HENNING refers him to the reports of Prof. BAUSCHINGER, of Munich, vols. 7 to 11; those of Prof. MARTIN, of the Royal Testing Laboratory at Berlin; the works of Prof. JENNY, of Vienna; also to the results of experiments at the Watertown Arsenal in the reports of the War Department for 1886 and 1888.

A. C. C. asks where he can obtain full information concerning sewers or drains constructed of sand and cement, their advantages and disadvantages; also details of any construction of a sewer without the use of brick or tile, in which cements form the principal part. We can only refer generally to the large amount of information on these subjects which has appeared in this journal and various society papers, and which is partially embodied in a considerable number of books. It is natural to desire to find the sum of human knowledge on any given specialty which one has to look up already collected in some live publication, but the wish can rarely or never be gratified. As a rule, a long hunt through many different sources of information is necessary.

A. F. BENSON, now of Milford, Ill., says that he will forward at the earliest opportunity his answer to the numerous inquiries he has received concerning his method of finding the true meridian as promised in our issue of Sept. 26, 1891.

Practical Results in the Magnetic Concentration of Iron Ore.*

The writer does not claim a right to discuss this subject as a furnace-man or user of iron ore in this new form. His efforts have been confined to mining, preparing and separating the magnetic ore from the gangue. Two years' experience in experimenting and another two years in producing concentrates on a commercial scale have led me to believe that the new trade of making concentrates must be well learned in all of its details. If there have been any partial failures in this most useful branch of the iron business, the failures have been caused chiefly by inexperience or lack of patience. Although I have, within the past five years, constructed machinery for water-jigging and wet magnetic separation, I shall only speak of the dry magnetic process here.

Three years ago I was engaged by Mr. J. D. CHEEVER, the lessee of the Croton magnetic iron mines, at Brewster, N. Y., to adapt an old water jigging mill to the magnetic process. The ore to be treated is described by Messrs. JOHN BIRKINBINE and W. B. KUNHARDT in a late report on the Croton magnetic iron mines, as consisting of compact, moderately fine grained magnetite in a gangue composed mainly of quartz and hornblende, besides feldspar, apatite and mica, and more or less pyrite and pyrrhotite, and they say "it is highly satisfactory that the grain of the ore permits a fair disintegration of its constituents by crushing it to pass a 12-mesh screen, inasmuch as a finer mineralization would increase the cost of concentration, as hereafter described."

Similar descriptions have been given by Mr. EMERSON MCMILLAN, Mr. F. W. GORDON and Prof. N. S. SHALER.

By these gentlemen the average amount of metallic iron in the ore beds is stated to range from 37% to 42%, the average sulphur from 1.7% to 2.2%, and the phosphorus from 0.076% to 0.426%. Practical work has shown the average amount of phosphorus to be 0.232%. Since May 1, 1891, we have been roasting and concentrating this material to 68% in metallic iron, 0.44% in sulphur, and 0.038% in phosphorus. Previous to this the concentrates ran about 66% in iron.

Up to Sept. 1, 1891, opening by drifting and prospecting with the diamond drill has exposed at least 8,000 000 tons of ore; while it can be seen by a fair examination of the property that there is not less than three times this amount of ore in these mines, and this estimate does not include the mining rights owned personally by Mr. J. D. CHEEVER.

Professor SHALER says:

The considerations previously given concerning the horizontal extension of this deposit beyond the limits of the present workings lead me to feel that it is reasonably safe to call the length of this bed 4,000 ft., the depth within workable limits 1,500 ft., and the width 75 ft. These estimates can be more fairly made than in the case of an ordinary vein, and, though not positively certain, have all the probability they would have if the deposit were a bed of coal. On this basis we have a total of about 50,000,000 tons of ore in the deposit. Of this mass, something like three-fourths may be regarded as mineable, the remainder being the leaner ores that cannot be profitably extracted at great depths, or ore which must be left in place to sustain the walls and roofs of the mines."

MR. F. W. GORDON says:

Very extensive workings and explorations show the deposit of ore to be one of the greatest in magnitude that has ever been developed in America. The explorations and developments have been intelligently made, and warrant an estimate of the quantity of ore in easy reach to be not less than 30,000,000 tons. As the name of the mine implies, the ore is magnetic or Fe_3O_4 in composition and dense in structure. Entries 15 to 20 ft. wide driven into the ore require no timbering to support the roof. The average of eleven analyses taken from the workings between June 6 and Aug. 13, 1890, gives the following composition:

Metallic iron	40.640
Phosphorus	.302
Sulphur	1.540

Before the old water jigging mill was erected, some eight years ago, the product of these mines was sorted to remove the more sulphury ore, and was shipped directly to furnaces making foundry irons. In order to meet the requirements of purchasers, the mining company was obliged to reject, in cobbing, 2½ tons to get 1 ton of shipping ore containing 51% of metallic iron and not more than 1% in sulphur. About 50,000 tons of this class of ore was shipped from these mines. The old dumps from this sorting are now being crushed and separated by the new process.

Mr. JOHN BIRKINBINE, in his paper on "Progress in Magnetic Concentration of Iron Ore" (Trans. Inst. M. E., xix., 656), quotes from the private letter of a member of the Institute an expression of emphatic doubt whether, at any American mine, it would pay to mine and concentrate a lean magnetite. The writer says: "So far as I can see at this stage of our practice, waste dumps only, or the rejected portion of an output, other portions of which have been shipped at a profit covering the whole cost of mining, can be used as the raw material of concentration."

Without repeating here the argument of this correspondent, or criticising his knowledge of the situation, and without asserting that magnetic concentration was a commercial success three years ago, I can assert and prove beyond question that the Croton mines have produced and sold at a fair profit from 50 to 220 tons of concentrates per day during the past year and a half; and the mill has been actually running but 20 months.

Commercial success in concentrating any ore includes economical mining, preparation and separation; but in the Croton ore the presence of sulphur calls for very economical roasting as well as economy in all the other processes. The cheap roasting of the ore of the Croton mine, which contains about 2% of sulphur, was one of the first problems encountered in reclaiming that property, and was really as important a factor as the concentration.

A series of experiments was made to determine the best size for economical roasting, and at the end of three

*A paper by W. H. HOFFMAN, M. E., Croton Magnetic Iron Mines, N. Y., read at the Glen Summit Meeting of the American Institute of Mining Engineers.

months a size that would pass through a 2¾-in. ring was adopted, as giving the most rapid work for the quantity of fuel consumed. Crude Lima oil is used for roasting. Through experiments conducted by our general foreman, Mr. T. BLASS, we found the average consumption of fuel oil to be 3.75 galls.; but by enlarging the combustion-chambers we have reduced this amount to a little over 3.6 galls. per ton of raw ore. The cost of the oil is 2¼ cts. per gall., making a fuel cost of 8⅛ cts. per ton of raw ore. The labor of filling and discharging amounts to only 3 cts. per ton, as this work is largely automatic. The average temperature is 1,250° Fahr. Davis-Colby roasters, remodeled to burn fuel oil, are used for a portion of this work, the remaining portion being done in a roaster of new type designed by the writer. The Davis-Colby roasters have been in operation nearly three years, and have done excellent service.

The ore is conveyed automatically from the roasters to the Sturtevant mills, where it is ground to 12-mesh size, all coarser material from the screens being returned to these mills by elevators. Barring the numerous experiments with various types of magnetic separators, the experiments in crushing have been the most elaborate. Nearly all the best known methods of grinding ores have been tried at the Croton mines during the past three years. Some of these machines have been tested for a year or more, but about 15 months ago we became thoroughly satisfied that the Sturtevant mill was far superior to any other machine for grinding iron ores. I consider it necessary to mention this machine thus somewhat prominently, as its economical and uniform granulation plays an important part in answering the question in Mr. BIRKINBINE's paper, "Does magnetic concentration pay?" If the ore is not properly granulated and screened, no known method of separation or concentration can make it a commercial success.

The screen block openings in the Sturtevant mills are ¼ ins. wide, and the coarsest material passing through them is less than $\frac{1}{32}$ in. thick, while the finest material would be rejected by a 60-mesh screen.

The ore enters the Sturtevant mills at a temperature of about 350°, being cooled from about 1,200° by a water bath on its way up the conveyer. Under these conditions the ore is quite friable, and we have no difficulty in grinding 22 tons per hour with the 20-in. mill and 16 tons in the same time with the 15-in. mill. One set of Sturtevant mill bushings will grind from 4,000 to 6,000 tons of ore, according to the depth of the chill in the bushing, the cost of each set being $16.00. The screen blocks for this amount of ore cost $9. This is less than one-half the cost of renewal on any other machine formerly used at our mill. At 22 tons per hour, the 20-in. mill requires 94 HP. to drive it, but it will be remembered that the product is finished on these mills. The 15-in. mill requires 70 HP.

The ground ore is elevated from the discharging nozzles of the Sturtevant mills to the several screens, covered with slotted steel plates made by the Harrington & King Perforating Co. The slots are $\frac{1}{32} \times \frac{1}{2}$ in. in some plates, and $\frac{1}{32} \times \frac{3}{16}$ in. in others.

The slotted plates are easily removed, and when the requirements are exacting as to phosphorus, we substitute plates of $\frac{1}{16}$-in. mesh on two of our five screens. We have demonstrated by exhaustive experiments that two sizes of screen plates, three sets coarse and two sets fine, will prepare the ore containing 0.420% phosphorus (the greatest amount we have in the mine) for a separation having 0.036%, with two passes on the magnetic separators. Ordinarily, the phosphorus in the Croton ore runs from $\frac{5}{10}$ to $\frac{6}{10}$. When the phosphorus runs higher than $\frac{6}{10}$, three sizes of screen plates should be used, delivering to three receiving bins, and each size should be treated separately on the magnetic separators; and I am positive that this treatment will insure a Bessemer product running not over 0.050 in phosphorus, using nearly any of the New York State magnetites that are free from titanium.

In some experiments we have used 18-mesh screens, and with ore prepared for this grade we were enabled to produce continuously, with two passes, concentrates showing 70.60% metallic iron, 0.018% phosphorus and 0.220% sulphur. Of course the silica was extremely low. With the latest Hoffman separator, using 12-mesh screens and making two passes, we have produced concentrates showing 70.93% metallic iron, 0.017% phosphorus and 0.231% sulphur; and by using 18-mesh screens we can depend on 71% concentrates with one pass on this machine.

Examinations for the purpose of detecting screen, shute and bin leaks must be made at least twice a week.

The screens deliver their finished product to two bins placed on the floor above the separating department, each having a capacity of 80 tons. Eight shutes deliver the ore to the separators, nine in number. The separators were designed and constructed by W. D HOFFMAN and T. BLASS, at our mines. On eight of the machines the ore is passed before the magnets twice to bring the loss in tailings to 8%. I have lately designed two new separators, one of which is giving with one pass concentrates of 68% to 70%, with a loss of only 6½% of iron in the tailings. As patents are now pending, these machines cannot be described here. People frequently ask how much it costs to separate the iron ore from the gangue. We always reply, as little as any other portion of the process; 7 cts. per gross ton of concentrates is a liberal allowance, and this includes all repairs to separators. We shall reduce this to less than 6 cts. soon. Repairs and supplies throughout our milling plant amount to 1.8 cts. per ton of raw ore ground. Hence, it will be readily seen that *the* feature of the problem of magnetic separation is the initial mill grinding or granulating. The very cheapest process is absolutely necessary, as most of the ores to be reclaimed will analyze less than 40% metallic iron, and that means from two to three tons of ore to produce one ton of concentrates. Using Sturtevant mills and 22% ore we can pay a small profit at our plant. Crushers and rolls require 28% ore to pay at the present price of concentrates. We contract our mining and initial crushing ready for and delivered to roasters to Mr. CHARLES VIVIAN, of Brewster, N. Y., at an average price of $1.38 per cu. yd. The ore weighs from 5,500 to 6,800 lbs. per yd. We are selling concentrates at present to six furnaces, which use from 35% to 55% of them in their regular mixture. The furnacemen tell us that their flux and fuel are reduced, but most of them decline to give the exact amount. We have yet to receive a complaint from any of our customers as to quality or fineness. I have personally witnessed the use of several hundred tons of our concentrates at the experimental Ramel Conley steel works near our mines. They were used in various ways; sometimes loosely thrown in the bath, and at other times made into briquettes and charged in the open-hearth furnace along with the biles of scrap of African ore.

Every one of the practical open-hearth melters employed there at different times has informed me that he was surprised at the rapidity with which he could handle the furnace when using concentrates, and I understand this has been the experience of others. There is no difficulty found with the blast at Scranton, where concentrates have been used by Mr. E. MOFFATT for several years.

An accurate, though condensed, statement of the cost of mining, crushing, roasting, preparing and separating one gross ton of 68% concentrates from $2\frac{1}{5}$ tons of 38% ore, according to the present daily practice at the Croton mines, is given below. The tailings run, in iron, from 7% to 8%. About one-third of the ore is taken from the old dumps. On the basis given below, 580 tons is crushed every 20 hours, with a production of about 265 tons of concentrates in the same time:

Statement of Cost.

Mining, crushing and delivering to roasters $2\frac{1}{5}$ tons of raw ore, at 2¼ gross tons per day	$1.13
Roasting, including top filling	23
Handling at roasters	03
Preparation and screening	22
Daily renewals, supplies, and repairs of all machinery and roasters	05½
Separating, including labor and power	07
Delivery to Harlem R. R. switch, including railroad repairs	04
Office and laboratory expenses	04½
Insurance, interest and taxes on plant	13
	$1.95

During the last winter and spring, a continuous run of 5 months was made of 20 hours each day, and the average cost of a gross ton of concentrates for the whole term was $2.10. Improvements have reduced this amount to the figures of $1.95, given above. Analyses are made at our laboratory daily of ore at mines, ore after leaving roasters, concentrates and tailings, by Mr. G. K. VOLCKENING, Jr., our chemist.

The following analyses cover an average two weeks' shipments in July, August and September of the present year. All concentrates were from screens with slots $\frac{1}{32} \times \frac{1}{4}$ in., and all samples were from car-loads:

	July 7.	July 15.	Aug. 27.	Sept. 5.
Metallic Iron, dried at 212° F.	68.55	68.080	68.250	70.090
Phosphorus, " "	.0355	.0368	.030	.045
Sulphur, " "	.240	0.340	.475	.170
Silica, " "	3.500	3.610	2 951	2.513

Legal Decisions of Interest to Engineers.

Effect of Defective Work on Assessment.—Where a contract for paving a street was regularly let, and the work was accepted by the board of public works, the fact that the material used and the work done were not such as the contract called for is no defense against an assessment made to pay for the paving, as required by the charter of the city, and a court of equity will not enjoin the collection of the assessments.—Dixon v. City of Detroit, Sup. Ct. of Mich., 49 N. W. Rep., 628.

Grant of Exclusive Municipal Franchise.—The grant by a city of an exclusive franchise for a term of years to supply the city with water is void on the ground that it creates a monopoly. But a citizen cannot, merely because such a contract is illegal, commence an action to set it aside, unless he can show that water can be secured on better terms. The proper time to avoid that contract is when a better one is presented. It is the monopolistic phase of the contract that is void, and not its operation.—Allgeit v. City of San Antonio, Sup. Ct. of Tex., 17 S. W. Rep., 75.

Soundness of Bridge Stringer.—In an action against a township to recover for injuries caused by the breaking of a stringer of a bridge over which plaintiff was passing with a load of stone, the evidence showed that the stringer had been in use three years, was 12 × 14 ins., was rotten in the center, although it appeared sound, and had from 2 to 3 ins. of sound timber around the outside, and that it splintered for several feet on each side of the break, and that a traction engine, weighing 3 tons, was run over the bridge about two months before the accident, and that the township authorities examined and tested the stringers about that time. The township authorities were not negligent and plaintiff could not recover. O'Neil v. Township of Deerfield, Sup. Ct. of Mich., 49 N. W. Rep., 594.

A New Joint for Inclined Struts.

A new joint for struts lying in planes inclined to each other has been devised and patented by Mr. CHARLES STEINER, of 204 La Salle Ave., Chicago. The purpose of this joint here illustrated is to unite the members firmly and compactly with their axes

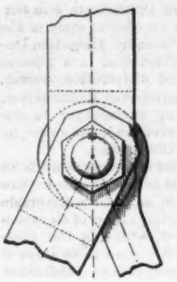


Fig. 1.

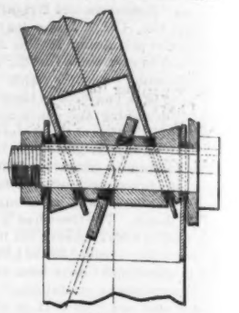


Fig. 2.

all intersecting at a given point, and yet leave the struts free for slight adjustment or movement.

Fig. 3.

In the cuts given Fig. 1 is a side elevation, Fig. 2 is a side sectional view taken on the center line of Fig. 1, and Fig. 3 is a detail view of the bolt and bar lug, showing its use with a bolt hole washer. In the views shown the struts are supposed to be of the usual form, excepting that the upper one is inclined with reference to the pin; the tie bar is also inclined.

The bolt holes in the inclined members are made larger than the pin, and in this opening is placed a bolt hole washer also larger than the pin, and with an inside face made to fit the surface of the pin. To hold these washers in place, and to pack the joint, a series of skew washers are then used as shown, and the joint thus put together is finally held by the nut on the end of the pin. To prevent these washers from being displaced during the operation of tightening up on a circular pin, a small key is employed, shown at the inside head of the pin.

As the bolt hole in the inclined member is cut at right angles to the axis of that member, and fits upon the exterior of a circular washer, it is evident that this member is as free to move within small limits as if it revolved on the pin itself.

The Folsom Dam.

We present in this issue plans and views from photographs of the Folsom Dam in California for which we are indebted to the *Mining and Scientific Press*, of San Francisco. This dam was built by the Folsom Water Power Co. and impounds the water of the American River. It was constructed mainly by convict labor, the site being near the Folsom State Prison.

It is founded on the granite bedrock of the river and upward of 20,000 barrels of Portland cement were used in its construction. The dam is 89 ft. high, 87 ft. wide at the bottom and 24 ft. wide at top; with the bulkheads at either end is about 650 ft. long. It contains 48,500 cu. yds. of granite masonry, laid in blocks each of some tons weight. The front and back walls are coursed with a filling between of rubble laid in concrete.

For a length of 185 ft. the center of the dam is 6 ft. lower than the sides, and this portion is fitted with a wooden movable dam or shutter, hinged to the top of the dam. This shutter is only used in a low stage of water and is then raised by five hydraulic jacks set in the masonry.

A heavy granite wall extends from the dam, forming the outer bank or line of the canal, for a distance of nearly a mile. The wall measures upward of 15,000 cu. yds. About 1,200 ft. below the dam, on the east side of the river, is located the Folsom State Prison. At this point the level of the canal drops about 8ft. to afford to the State, in payment for the convict labor, a water power to be developed in the prison yard, where the State is now building a power house to utilize this power. Six powerful water-

wheels and other machinery have all been provided, and are on the ground. The wheels are 87-in. Leffel turbines, No. 2 "Special."

The Folsom Water Power Co.'s Dam on the American River, Cal.

The work below the prison is simply excavation, considerable of which work has already been done. A broad-gage railway, belonging to the Folsom Water Power Co., extends along the outer bank of the canal from the dam to the town of Folsom, where it is connected with the general railway system of the state.

There has been expended on the work by the Folsom Water Co. and by the State of California more than half a million of dollars. The benefits to spring from its completion are both of a public and private nature.

The erection of this dam has formed a "still water basin" about 3 miles long in this section of the river above the dam. Under franchises from Sacramento and Placer County the American River Land & Water Co. has built across the river a heavy timber boom, supported by 3 massive granite masonry piers, each upward of 50 ft. high and 50 ft. wide on the base. They have erected a sawmill at the boom, and float down the river to the mill large quantities of logs from their forest properties on lands on the upper branches of the river. Careful and complete estimates show that on these lands there is now standing upward of 360,000,000 ft. of pine lumber, which, by the river and the boom, can be brought at great profit to the market. This is but a portion of the timber land so located tributary to the boom.

The East Side Bulkhead During Construction.

The Folsom Water Power Co., foreseeing that, upon the completion of their canal, during a portion of the year all the water of the river could be diverted from the river bed, obtained more than 20 years ago the right to mine the river bed, and said right is protected by U. S. patent. This right they have protected jealously, and so soon as the first section of the canal is finished they will be able to commence such mining.

One of the engravings shows an elevation of the east side bulkhead while being constructed, by which the massiveness of the structure can be understood. It is now 18 ft. higher than the cut shows it. The water is drawn from this to the power-house and drops 7.33 ft. where it is utilized on the Leffel turbine wheels for power at the prison. After leaving the wheels it passes into the canal and flows on to Folsom. The contract with the company is that the State furnishes all the labor required to complete the work down virtually to Folsom, and this is given in payment for the land on which the prison is built and the perpetual use of the power, with certain other privileges. The power will be used at the prison for pumping, lighting and the jute-mill. The power-house in which the wheels are to work is built of stone, and the walls are now up. The wheels are in place in their concrete arches ready for the water.

The irrigation feature is an important one in this plan, as may be imagined when it is stated that water can be delivered to between 400,000 and 500,000 acres of land. It was at first thought possible to supply water to some 200,000 acres, but special surveys have been made, extending over many months, and it has been ascertained that the canals extending from this dam will deliver water to a much larger area than was originally supposed. The area will include all that region between the Cosumnes and American rivers on the south, and the American and Bear rivers on the north, extending, in fact, to within 2 miles of Wheatland, in Sutter County. It is the intention to utilize the waters of the American River by storing them in immense reservoirs during the months of most copious flows, and distributing them when needed. All of this water has been going to waste.

The Folsom Water Power Co. (the offices of which are in San Francisco) will carry the water to Folsom, where the principal power will be developed. A cable will be extended from this point to Sacramento, 18 miles, and electric power furnished in quantity to that city for light and power. The capital city will be enabled to have all the electric power it needs when the plans of this company now being perfected are carried out.

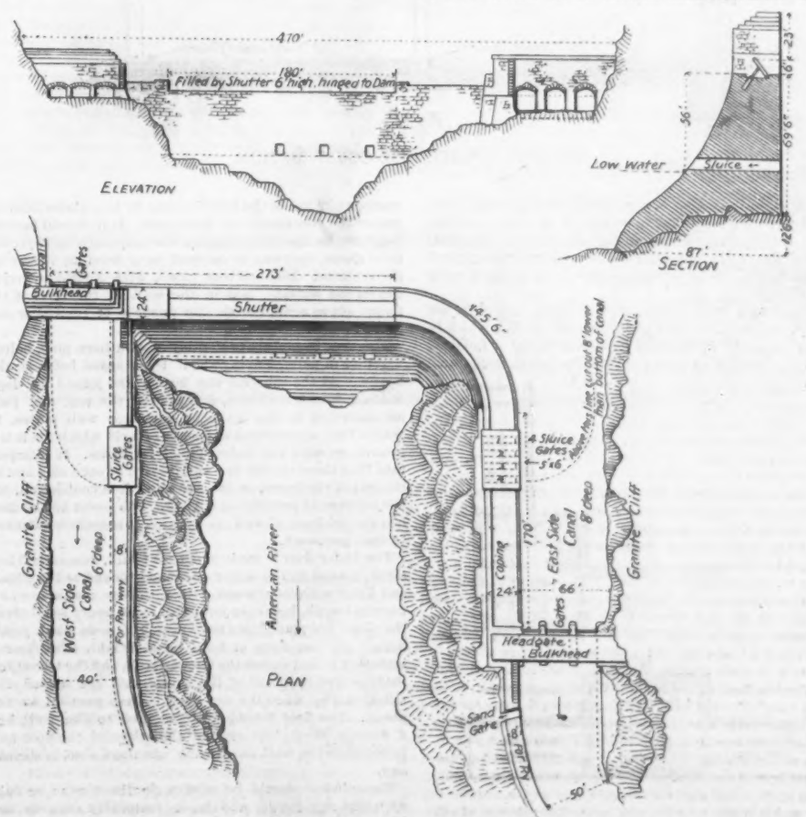
The granite for building this dam is taken from the banks of the river on the spot. It is first class material in every respect. It is used not only in the dam, but in the bulkheads, houses, etc.

The original foundation of this dam was laid as far back as 1866. In 1886 the new foundation of the present structure was laid on the old foundation, and the dam was finished in 1891. The entire works can now be completed so as to make a large portion, if not all, of its power available early next year. The dam is a splendid one, but had to be made very strong. The river is one that sometimes rises as much as 60 ft. in a few hours, and in flood times is a torrent of magnitude. From the crest of the dam to the level of the water below (as shown in the cut), the water falls about 57 ft. The engravings show the headworks of both the east and west side canals, plan and elevation of the dam, with section, etc.

It will be noted by our readers that there is a side spill-way in this dam of a character practically similar to that proposed for one of the dams yet to be built for the New Croton Aqueduct.

Standard Storehouse Construction.

Through the courtesy of Mr. C. J. H. WOODBURY, Vice-President of the Boston Munufacturers' Mutual Fire Insurance Co., we present illustrations of a standard storehouse construction, as designed by Mr. WOODBURY and recommended by that com.



Plan Showing Dam and Headgates.

pany. This standard is thus described by the engineer:

These illustrations represent the salient points in design for a mill storehouse several stories in height, and include many features found useful in practice for convenience in operation, and also securing the greatest measure of resistance to fire.

This plan is not intended to take the place of the services of any mill engineer, but rather to assist in such work. This office holds itself in readiness to furnish to its members estimates of the strength of floors. It is important that the floor beams should be designed to sustain the greatest load ever to be placed on them, and the stories should be made low enough to prevent overloading, and also to prevent bales of material from being piled to great height, the preferable method being to place bales on end.

A storehouse one story in height is recommended in preference to this design whenever there is sufficient quantity of level land at disposal for this purpose, as being cheaper, more convenient, and, when separated into small divisions by fire-walls, the safest method of storehouse construction.

On reference to the drawing it will be seen that the floors are continuous, without openings, and of the standard slow-burning construction—a type which has not yet been burned through by any fire starting under such a floor, unless there have been openings in the floor. To reduce water damage, the floors are not level, but have a camber of 2 ins. in the middle made by iron plates inserted under the columns in the basement. If it should become desirable to use the building for any purpose requiring level floors, they can be reduced to a level by removing these plates. Inclined iron tubes, with a light swinging cap on the outside, laid in the wall at the level of the floors, act as scuppers for the purpose of removing any water.

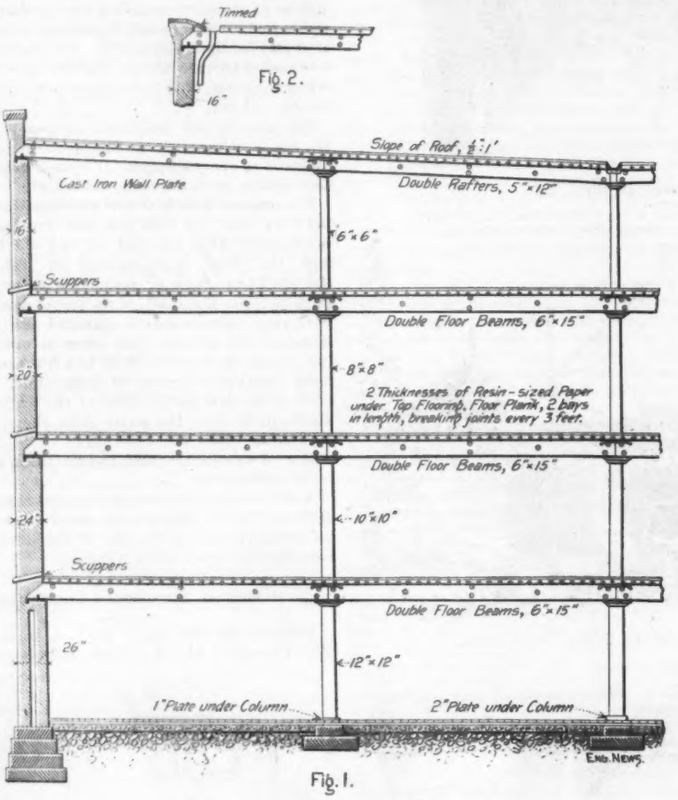


Fig. 1.

STANDARD STOREHOUSE CONSTRUCTION.

The floor beams are preferably of Southern pine, bolted together in pairs, leaving about 1 in. space between the beams. At the columns the beams are joined by dogs made of ⅝ in. round iron, driven in at the top, and they are anchored to the walls by cast iron wall plates, to which they are secured by means of a rib which fits into a groove crossing the under side of the beam. It is important that there should be a small space at each side and at the end of the beam, in order to allow free ventilation, for the purpose of preventing dry rot. The Goetz box anchor is a special form of wall plate which is especially adapted to such purposes.

The under floor is made of spruce plank, generally 3 ins. thick, planed on the under side, and grooved at the edges, and fitted with hard wood splines. These plank are two bays in length, breaking joints at least every 3 ft. Over the plank are placed two thicknesses of rosin sized paper before the top floor of hard wood is laid. The floor is smoother if laid across the line of plank, and the travelling loads moved in or out of the storehouse are better distributed than when the top floor is laid parallel to the plank. The floor should not be secured to the wall, but a narrow strip, laid around the edges of the floor and fastened to the wall, covers any openings due to shrinkage.

The columns should be square Southern pine or oak, with iron cap, pintle, and base, preferably cast in one piece, and secured to the under side of the beam by six-inch lag screws. The caps should be large enough to give the beams ample bearing surface.

If brick piers are placed in the basement, it is preferable rather than to insert bond stones in the piers, to use a plate of boiler iron the size of the pier, and containing a number of inch holes punched on both sides over a board, in order to produce as large burrs as possible, to securely hold the masonry.

It is generally preferable that the roof should slope toward the center one-half inch to the foot, and the gutter should slope toward the drain pipes one-twentieth inch to the foot; but if the roof slopes toward the walls, the detail of cornice, Fig. 2, illustrates the arrangement of gutters.

Access to the various stories is obtained only by means of a tower outside the main building and extending above the roof, containing stairways, elevator and water pipes. At each story of the tower open galleries communicate to the rooms on that level. A doorway from the upper story of the tower affords a ready means of reaching the roof. It is often a matter of great convenience if the doorway at the first story of the tower is made large enough, and at the outside grade, so that a wagon can be backed directly to the elevator. It is unnecessary to provide these elevators with automatic hatches, as guard gates serve every purpose. For the elevators in such towers either hydraulic system or electric motors frequently furnish more convenient means of applying the power than steam.

The system of tram rails hung from above, in connection with triplex blocks as constructed by the Yale & Towne Mfg. Co., is a great convenience in handling the contents of storehouses.

The walls extend above the roof, and the parapet should be laid in cement, because the moisture readily absorbed by brick would otherwise pass downward and render walls in the top story damp. In some instances a course of brick dipped in coal tar is laid above the roof level. The illustration (Fig. 2) shows a method of protecting a low parapet wall by plank which is tinned. This form of parapet also tends to reduce the amount of snow lodging on the roof.

The window openings are small, and omitted on sides exposed to other fire risks; but if there is any contingency that the building will ever be used for other purposes, it is advisable to lay the walls with arches and panels, in which openings can be made suitable for windows of larger size, necessary to furnish light for manufacturing purposes.

In addition to yard hydrants near the buildings, there should be a 6-in. standpipe in the tower, with two 2½-in. hydrants and hose at each story, and at the top story of the tower the standpipe branches to a Morse monitor nozzle on the roof, if there are any adjacent buildings which might be reached by streams from this position. A set of plugs for the roof drain pipes will allow the roof to be covered with water in case the property is endangered by sparks from burning buildings. Automatic fire alarms with thermostats form a valuable auxiliary to the fire apparatus in the storehouse. If the contents of the storehouse are of such a nature that automatic sprinklers are advisable, it is preferable to shut off the water during freezing weather, rather than to rely upon the devices known as dry pipe systems.

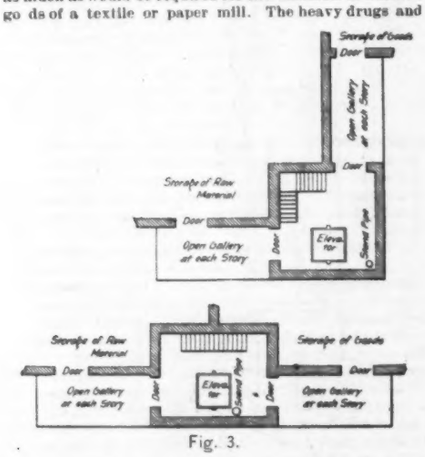


Fig. 3.

dye-stuffs would be placed on the ground floor. For convenience, as well as to separate the different hazards of raw material and finished goods, the building may be divided into two sections by fire-walls extending through the roof.

A 5-ft. Flexible Joint for a Submerged Steel Water Main.

In connection with the new intake conduit recently completed at Toronto, Ont., 15 flexible joints 5 ft. in diameter and 65 joints 4 ft. in diameter were used.

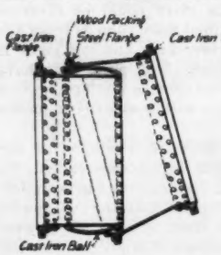


Fig. 1. Section.

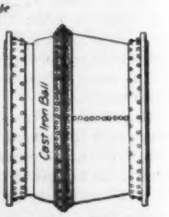


Fig. 2. Elevation.

A section and elevation of the 5-ft. joint are shown by the accompanying cuts, Figs. 1 and 2.

The pipe used for the new conduit is ⅝-in. single riveted Scotch steel boiler plate, laid in lengths of 55 ft. for the 4 and 57 ft. for the 5-ft. pipe. The flexible joints have a body of the same material with a turned cast-iron ball riveted on the ball end, while riveted to the inside socket end is a U-shaped rim. This rim is filled with soft English pig lead, projecting ⅛ in. beyond the rim and working upon the plain surface of the rim. As shown by the section, Fig. 1, there are two of these rims, one riveted to the socket, and a second secured to a steel flange projecting beyond the socket, this flange being fastened to an-

other, directly above the first rim and secured to the socket. A wood packing is used between the two flarges.

The 4-ft. section of the conduit is 4,660 ft. in length and parallels and supplements a 36-in. cast iron pipe, extending from the pump well across the harbor to a connecting crib at Hanlan's Point. This section is in 14 to 24 ft. of water, on an irregular bottom, which in some places was blasted and dredged to a depth of 8 ft.

The 5-ft. section of the conduit is 6,027 ft. long, and extends from the connecting crib at the end of the 4-ft. section across Blockhouse Bay and through a cutting in an island to a crib, where it joins the 72-in. intake extending into Lake Ontario. For this section the trench was dredged in soft clay and the 15 joints were used to give flexibility in case of settlement and for facility in laying, the necessity of laying to exact grade being obviated.

The connections between the 5-ft. joint and the pipe were made by means of cast-iron flanges having a faced projection of ¼-in., upon which rested pine packing. The packing was put in position above water and fastened with wire through the bolt holes.

The 4-ft. pipe and joints were riveted directly together. Where joints were unnecessary, sleeves of the same material as the pipe were riveted on, making 110-ft. lengths.

In laying the 5-ft. pipe a flexible joint was first used, after which the forward end of each succeeding length was blocked up from 1 to 3 ft. higher than the other end, until another flexible joint was used. The extra weight of the successive lengths finally sunk the blocking into the soft bottom, while the flexible joints prevented too great leverage.

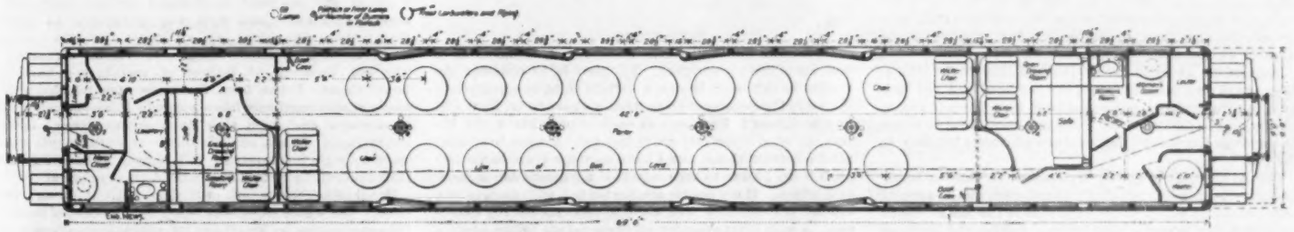
Most of the bolted joints were made under water by divers, the forward end being blocked with boxes of 2-in. hemlock filled with sand, or suspended from scows by means of chains.

The above description is abstracted from the report of the engineer, Mr. W. C. BROUGH, which, with the cuts, is given in the last annual report of Mr. WILLIAM HAMILTON, Superintendent of the Toronto Water-Works.

The joints were furnished by Mr. W. H. LAW, Peterboro, Ont., the price being $180 for the 4-ft. and $212 for the 5-ft. joints.

Pullman Palace Parlor Car.

In our last issue, in an article upon American cars for English railways, we gave dimensions and particulars of some of the cars built by the Pullman Palace Car Co., of Chicago, Ill., and we now give a plan of a Pullman parlor car. The length of the body is 69 ft. 6 ins.; length over platforms, 75 ft. 6 ins., and length of main saloon, 42 ft. 6 ins. The platforms are vestibuled. At one end of the car are the heater, porter's locker, women's toilet room and closet, and a drawing room. At the other end are a locker, men's closet and toilet room, and a drawing room or smoking room. As shown in the plan, this is arranged as a drawing room, but it may be converted into a smoking room by placing the movable portion of the sofa against the partition *A*, closing the door *A* and opening the door *B*. The main saloon or parlor has bay windows on the sides. The car has seating accommodations for 34 passengers—24 in the saloon and 5 in each drawing room. The lighting is by the Pintsch compressed oil gas or the Frost dry carbureter system (gasoline), and oil lamps are also provided. The arrangement of this car differs from that of the Wagner car illustrated last week, in having the smoking room inclosed.



PULLMAN PALACE PARLOR CAR.

Bridge Design.*

FOUNDATIONS.

The simplest form of foundation under water is, probably, the timber platform, with or without concrete filling, and placed with its top below low water by means of a pit or coffer-dam. This can only be used with safety and ultimate economy where the soil furnishes a good bearing surface at an easy depth below low water. It should never be used except for abutments on streams with easy currents and for piers resting on solid rock at a moderate depth under water.

In deep water where the bottom is good and easily leveled off, the timber crib has been used with fair success in many places. Another device for similar cases is the timber platform with detachable sides, forming a sort of watertight scow, in which the masonry is built till the platform touches the bottom and the stone work is above water, when the sides are removed leaving the platform in place.

All the above forms are open to objection if placed in midstream with strong currents, except on rock bottoms, as they are liable to be undermined, and if protected with riprap, the waterway is considerably diminished.

Where the water is of medium depth and the bottom shifting and unreliable but underlaid by firm strata of clay or other penetrable material, piling is generally used to secure a bearing beyond the reach of undermining. Pile foundations are of three general forms: In one the piles are driven inside a coffer-dam, which is then pumped out, and the piles sawed off and capped over with a timber platform below low water. In another, the piles are driven in the open stream, sawed off under water, and the platform and masonry are lowered upon them by means of guide-piles and hoisting tackle. In the third, the piles are either driven inside a boiler iron tube, or it is afterward lowered over them and filled with concrete. This latter is quite economical in localities where material is expensive, and if well done makes a fairly good pier.

There are, probably, more of the better class of bridges resting on pile foundations in this country than on all the other forms put together; and so well have they stood the test of use, that piles have come to be regarded as a sort of panacea for all engineering difficulties.

There are, no doubt, bridges in every-day use in which the current has carried away the material under and around the timber platform and left the pier standing, supported by the piles alone. In passing, a remark as to the legitimate use of piles may not be out of place. There are few instances of failure where piles have been driven to a good depth, capped over close to the ground and loaded in the direction of their length, but when called upon to resist horizontal loads, amounting to a large percentage of the vertical, they are liable to shift position if the material around their tops is not firm.

In the most important works of later years, the practice has been to carry the foundation to the solid rock by means of some of the methods using compressed air. This has been already successfully done to a depth of about 140 ft. below the surface of the water.

Another method of securing deep foundations is to sink an iron caisson, or timber crib, by dredging from above. This, however, lacks the certainty of a good bearing on the bottom, which is secured by the methods of compressed air.

Finally, as to foundations in general, it is sound economy in the long run to be a spendthrift under water, even if circumstances make it necessary to be a miser above.

In the matter of masonry it is doubtful whether we have progressed greatly, if at all, beyond the works of the ancients. With the assistance of the hoisting engine of modern type, we can probably handle masonry more promptly than ever before; but a speed in setting which places any considerable load on the mortar joints before they have had time to take considerable set is of doubtful utility, to say the least.

GENERAL DESIGN OF SUPERSTRUCTURE.

The general form of truss which combines the maximum of strength, stiffness and economy is a matter about which the doctors disagree somewhat. A few points however, are common to nearly all the best modern designs for through bridges.

The end posts are inclined, and run across one or two panels as the span is short or long. The lower chord is straight, with the possible exception of the end panel, which may be inclined to conform to existing masonry. The upper chord is straight in short spans, where the difference in strain is not great from end to end; but in long spans it is curved to something near an approximation of the parabola but with straight segments.

Some designers deflect the chord at each panel point, but it is doubtful whether they secure much ultimate economy over those who content themselves with fewer deflections and simpler details. The latter class, in spans of medium length, simply incline the chord each way from the center, and secure a good share of the economy arising from increased center depth with very little sacrifice of simplicity of detail.

The compression members of the web are placed vertically, and the floor beams secured to them as rigidly as possible. The tension members in the web cross a single panel, and in long spans a sub system is used to reduce the length of the principal panels. The old, short panel and shallow stringer have given way to the long panel and deep, stiff stringers, braced so as to form an independent plate girder span.

In deck trusses there is seldom very much latitude as to outline of truss. The inclined end post is most economical, if it can be used. The top chord is straight, and often carries the floor direct, or the floor beams rest on top. The bottom chord may be curved with considerable economy, where the clearance below will admit. There is no particular form of web adhered to, the triangular system often giving as good results as any.

PLANS AND SPECIFICATIONS.

The general plan should show all outside conditions, depending on the particular location, which it is necessary to meet, and give an outline of the form of structure desired. Further than this it is hardly desirable to go, unless a full detail plan is made.

The specifications should define the conditions which are necessary to the structure itself, and which are common to all others of its class, viz., the live load and the necessary data for the calculation of the dead load; the unit strains for the different materials which will be admitted, and for all the conditions under which they can be used; the general conditions for calculation; the details of construction; the quality of material.

It is probable that, under ordinary conditions, the best general plan and specification is that one which, between reasonable and necessary lines, leaves the greatest possible scope for originality of design in form of structure, details and material.

DESIGN OF DETAILS.

The province of the detail designer is, generally, to take up the work where the general designer leaves off, and localize it to the practice of the particular shop in which it is to be executed.

The detail designer should have sufficient experience to rightly interpret the general plan and specification. He should be acquainted with the "red tape" of the office. The different manipulations of material in the shop must be carefully studied. The laying off, by template or multiple punch, must be predicted beforehand, and the rivet spacing adjusted accordingly. Care must be taken not to exceed the capacity of the punch, shear, riveter, planer, boring mill, lathe, crane, furnace, hammer or other tool, or the work is liable to come to a sudden standstill.

There is often a choice between different methods of execution, as, for instance, an expensive forging, of which only a few are required, may be replaced by a riveted detail of slightly greater weight, but cheaper in the item of workmanship; and again, a clumsy riveted detail, which is often used, may be reduced to a standard forging and made in quantity with economy.

Leaving aside the question of tools and machinery, it will sometimes be found that what is comparatively easy to execute in one shop is, on account of what our friend HERBERT SPENCER terms the "Personal Bias," very hard to get done in another. To speak more plainly, few shops, which are old enough to be capable of thoroughly good work, are entirely free from over-conservatism, and sometimes even a trace of fogyism.

The designer should be thoroughly posted as to the capabilities of the mills, so as not to include anything which is not a commercial possibility; and, while he should confine himself to the more used, and, therefore,

* Slightly condensed from a paper by Mr. HARRY J. LEWIS before the Engineers' Society of Western Pennsylvania.

cheaper shapes, yet he should be thoroughly conversant with the special shapes, which may help him out of a tight place. It is always best to make the variety of shapes as small as possible, as this greatly facilitates the obtaining of a complete bill of material. Shapes are more readily obtained if all of one weight, which remark applies also to the cross-section of bars, but universal mill plates may be varied at will, providing each item will use up a billet of moderate size. Hence, in making up sections containing plates, it is better to vary them by changes in the plates than in the angles or other shapes. In this connection we might mention the tendency to use material capable of resisting high unit strains, which at present is confined mainly to the longer spans. This results in cutting down the amount of material necessary to carry the live load, and also in a reduction of the dead load. This increase in unit strains and the consequent raising of requirements as to quality of material, if carried too far, results in an increased cost per pound, which considerably diminishes the apparent gain, as the mills are quite prompt to take revenge on the individual who gets too far ahead of the procession in his specification for material. It is not improbable that medium steel will be used before long under the same specification for workmanship as iron, for the reason that it can be cheaply produced of such quality that a punched hole in it will stand even more abuse in the drifting test, and it can be punched closer to the edge, without apparent injury, than iron of the same dimension.

TRUSS DETAILS.

The end shoe receives its load from the pin exclusively, and is free to move through a small angle without obstruction in order that the truss may be free to deflect, and the shoe to adjust itself to an even bearing on the masonry without producing bending strains in truss members. A cellular bottom, with vertical ribs crossing the direction of the bolster plates, is necessary in heavy spans to distribute the end reaction evenly over a sufficient area of masonry.

With regard to the hip joint it is quite generally agreed that provision should be made to transfer all strains through the pin; but while some designers leave the joint between chord and end post open from ¼ in. to ½ in., others make the contact as perfect as possible. The latter is certainly a neater finish; but it is, nevertheless open to the theoretical objection that it may cause bending strains in case of unequal deflection, and it should not be attempted except where first class workmanship can be secured.

In the straight chord joints most designers assume the strains to be transferred through the abutting ends, and only provide enough splice plates to hold the members firmly in position. Sufficient pin bearing is provided to take up the maximum increment of strain produced by the web members.

The end connection of the intermediate post to the pin is one of the most troublesome details in the whole truss, for everything else seems to have the right of way over it, through it and around it. The connection is often in such close quarters that the pin can only be reached by a flat web, and such a variety of post sections is used that it is often quite a problem how to join the two without leaving a point weaker than the main member.

Tension members in themselves are easy to handle, as they are of two general forms, the bar head and the loop eye; but the designer will sometimes find himself put to his trumps to find room for them and pack them so as not to converge too sharply nor produce excessive bending in the pin.

The old practice of giving a considerable camber to the truss has been quite generally abandoned, and at present only enough is put in to keep the pins of the loaded chord from dropping below a straight line joining the two end pins when the span is fully loaded.

The top struts are usually built the full depth of the chord and rigidly attached to it, top and bottom. There is a considerable variety of opinion as to the mode of attaching top lateral rods. Some connect to a wing plate on the chord pin, while others attach them in the plane of the top flange of the struts, and give this flange sufficient section to carry the full strain. In long spans where considerable section is required, a good plan is to use a double system, top and bottom. Some very good work of later years has been built with rigid diagonal members in the top lateral system, but this is quite likely to prove troublesome in erection.

Portal bracing under heavy strains should also be attached to the top and bottom flanges and not to the web. One very common fault of curved chord bridges with long end posts is to put a splice in the post, just about the point of maximum bending from the portal.

Intermediate sway bracing is of rather doubtful utility, except where the column length can be bisected in both directions.

In long spans, which require large sections in the lateral system, the arrangement of the lateral system of the loaded chord, so as not to produce bending moments in the posts and beams, and so as to transfer the longitudinal strains symmetrically into the chords, furnishes one of the most troublesome problems in the whole truss. The first condition to be met is that the center line of the diagonal members must intersect the center line of the beam or cross strut in the vertical plane through the center of the chord. With a proper arrangement of details, this relieves the beam from bending strain. As the diagonal members cannot be made to intersect the center line of chord in the horizontal plane, and at the same time fulfill the above condition, some device must be used to avoid or counteract the bending in the post. When a single system of rods, above or below the chord, is used, the bending in the posts is taken care of by rods from an adjacent chord pin to a point well up in the post. Again, a double system of rods is sometimes used, in which one set is connected above and the other below the chord to a U plate, which bears on the center of the pin. Another very neat arrangement is the bifurcated lower chord in which the diagonals run to the theoretical center lines of the chords, which are themselves divided and connect to pins above and below the beams. This, however, necessitates a rearrangement of the truss members, which is troublesome and expensive.

With regard to floor beams, it is quite generally agreed that they should be rigidly attached to the intermediate posts wherever it is possible, and in such a manner as to load the post symmetrically. The strains from the lateral system should, as far as possible, be taken up by the lower flanges.

The arrangement of longitudinal stringers in long spans forms quite an intricate problem on account of the differential lengths between stringers and chords. When stringers with rigid attachment between floor beams are built to the chord length under full load, erection is rendered difficult, and the beams must be bent transversely in order to assemble the truss. Some designers overcome this difficulty very neatly by treating each panel of stringers as an independent span, with provision for expansion. In using this detail it is best to attach the stringers rigidly to one side of each beam, in order to counteract any tendency of the beam to get "in wind" under unsymmetrical loading. The above difficulty does not manifest itself in short spans, and in these the general practice is to fasten the stringers rigidly to the webs of the beams.

The use of metal stringers in preference to wooden floor joists in city bridges is increasing, probably owing to the greater strength of floor system rendered necessary by the various schemes of rapid transit.

Erection should be carefully looked after in the design, as money can be wasted more lavishly here than anywhere else. The truss should be self-supporting as far as possible, to avoid extra falsework and shoring up of individual members. The connections should be free from intricacy, so that the minimum number of pieces have to be supported, in order to assemble a self-supporting section.

From the foregoing it would appear that the intelligent designer must combine theory and practice, and, for that matter, the only way to avoid the old-fashioned conflict between the two is to combine them in one man, along with a proper judicial frame of mind. This recalls the remark of a young engineer, who said: "The engineer of to day should be a cross between a first-class mechanic and a college graduate"; not a bad parentage, by the way.

DISCUSSION.

THEODORE COOPER: In the designing of bridges I have had some little experience. My plan is to consider the matter in this way: Here is a certain thing to accomplish. Here are the points covering what we have to do. How will you do it best? I do not look back to see what I did before, or what somebody did before me. I have to accomplish a certain thing, and I have so much room to accomplish it in, I have to take care that my panels are in good proportion. If my panels are too long I will destroy my lateral system, and will have to reconstruct my diagonals. A man must consider all these points before he puts down the design on paper.

Now, I cannot illustrate that better than by referring to the work of some of our good friends on the other side. You all know about the Firth of Forth bridge, the clumsiest structure that ever was designed by man, the most awkward piece of engineering, in my opinion, that ever was constructed, from the American point of view. An American would have taken that bridge, with the amount of money that was appropriated, and would have turned back 50% to the owners, instead of collecting, when the bridge was done, nearly 40% in excess of the estimate.

How was that bridge designed? I will try to describe it to you as the engineer described it himself, only I will not use his words. There was a skeleton made on paper; it was varied once or twice until they had a number of skeletons. That was called a design. It was not. It was simply a lot of lines put on paper. After they got those lines on paper, they turned it over to the mathematicians. I will not say the mathematician is not a designer, but I will say that he is simply the man who handles the mathematical part. Take any man with a mathematical education, and will tell you exactly what the strains are and how they are to be applied. That is simply a matter of mathematical calculation. That was done. Then came the question: "Well, here we have a 12-ft. tube, and we have an 8-ft. tube, and we have a 5 ft. tube, and we have a 3-ft. tube, and we have to put them all together. Now, let any of you who have had experience in such work imagine the connection of these five tubes at different angles."

MR. BAKER said they found it impossible to put that on paper. It could not be done. The next step was to mold in clay. Now imagine, in these days, getting a lot of clay and molding it out before you could turn it over to the workmen. After molding it in clay and getting it nicely worked out, the engineers came and walked around it to see what sort of a thing had been designed. They knew it could not be built, and they concluded they had better back out a little and arrange for the flattening of those round tubes into squares. They had first started with the principle that science required the sections to be round, because that was the best possible form to put material in. But when they came to put them together they had to make all the ends square before they could get them together, and then they had to mark the rivet spacing on with chalk.

Now I say that is not designing, from my idea of engineering. We must consider all the points in the case and see how the particular work will be accomplished, and if we cannot make it in one way, try some other. That is the difference between the American designer of bridge work and the general European designers, especially the English. They simply make the general design and turn it over to the practical men, troubling themselves no more about it. Here we have to get out these details ourselves.

EMIL SWENSSEN: We often get strain sheets from outside parties to work up the details from and construct the bridge, and we very often find that the design has not been carried to the point that it should have been. For instance, we find when we want to design the eyebars that the top chord is too shallow or too wide. I have now one bridge in mind in which all the eyebar heads had to stick out on the top chord from ½ in. to 1½ ins. We had to slot out the holes, and that was not an English, but an American design.

W. L. SCAIFE: Some time ago there was a discussion in this society as to the effect of temperature on bridge material, and the general consensus of opinion seemed to be that a low temperature affected considerably the resisting strength of steel and iron, and that the effect of temperature should be taken into consideration in writing specifications. A committee was appointed to investigate the matter, but, like many other committees, has failed to report.

THEODORE COOPER: I do not doubt that where we are using iron to its maximum strength, cold has a very great effect in making it more treacherous at certain temperatures. But I do not believe it will have any effect at all within the limits of strain to which we use iron in our permanent structures, which is a distinctively different thing. Shapes and bars that we are constantly overworking I have no doubt are very seriously affected by severe cold; but permanent structures, where we are supposed to keep our strains within the elastic limit, so that there is no permanent change in the form of any member for any load that may be put upon it, I do not think are appreciably affected by cold. I do not think that the elastic limit of the material is changed to any appreciable amount. I have not seen any evidences to show that it was. Of course, we all know that the elastic limit is not a fixed thing. It varies constantly. The old humbug of fatigue of metals you have all heard about. It has been the basis upon which a great many young engineers have worked. It was largely used by German engineers also until recent times. It is a hobby based upon a certain series of experiments that were wrongly interpreted. It is a most unscientific and ridiculous thing to talk about the fatigue of metal.

Metal either wears out or it does not. It doesn't get tired. The whole thing was based upon a series of beautiful experiments by Mr. WÖHLER, which were wrongly interpreted. It has only been since more recent experiments have been made that the true interpretation has been accepted; that metal does not get fatigued, but it shows different results under different conditions for the reason that the standard of reference is changed constantly. A bar that has under a certain strain given certain results, under another strain will give a different result; but the condition of that bar should be measured from the original condition—that is, from the strain you start from.

THOS. H. JOHNSON: I have the information from members of the committee on the effect of cold upon metals that so far as their work has extended, it went to show that the brittleness in extreme cold, which gave rise to that paper and discussion, exists only in what is commonly known as "merchant bar" and similar grades of metal. The higher grade of metal required by first class bridge specifications is, if anything, a little stronger and less brittle when it is cold than at the ordinary temperature, so that really we have nothing to apprehend from that source, if we obtain the grade of metal that specifications usually contemplate and call for. It really becomes a question of more thorough inspection.

A MEMBER: In a bridge with curved top chord should the largest space be allowed on the upper side of the pin or on the lower side?

THEODORE COOPER: I think the principal reason why engineers have adopted the plan of cutting that joint away is on account of the mechanical difficulty of making

a decent job of it; and we would rather have a joint that we knew to be perfect, which we get by cutting away the chord and letting all the bearing come on the pin, than we do by trying to make a double joint, as we do if we try to make a bevel joint. I would advise cutting wherever the greatest error is likely to be. I have seen joints made from bevel joints, and when the pin was put in there was no bearing. Sometimes the holes were too large, and sometimes too small. The general opinion is that we had better throw them off altogether.

Mr. DE FORT: I agree with Mr. COOPER entirely in this respect. If we have a close joint we have to figure it with reference to both dead and live loads. Inaccuracies in shop practice will never make such an exact bevel that the bevel will be close at all times, or even at any time. If it is closed for the full dead and live load, it will be open if the train is only partially loaded, and of course that will throw a great deal of compression to one side of the upper chord instead of distributing it uniformly over the whole bearing surface; while, if we have an open bearing, we can say always rely upon sufficient surface on the pin—counting, of course, on the reinforcement plates, which we can figure pretty accurately, and we can transfer all the strain from the pin.

Speaking of cambering, I wish to inquire the best way to figure the length of the different members. There are three ways in use. The one generally used in Pittsburg to figure the mathematical length of the different members, shortening the tension members a little and lengthening the compression members. Of course that will not cause very much trouble in long spans. For instance, in a 500-ft. span suppose we take the full dead and live load. If we assume the modulus of elasticity at 30,000,000, and the unit strain at 5 tons, 10,000 lbs., the elongation will be 2 ins. That means that the end foot will travel 1 in. ahead of the end connection of the end stringer with the end floor beam, provided there is an end floor beam. Of course this will cause a considerable amount of strain on the rivets connecting these end stringers to the floor beams. They should always be attached to the floor beams in such a way that they can follow the expansion and contraction—can slide, in other words.

The second method of figuring the camber is that we take out the stretch or contraction caused by the dead loads. In my opinion, that is the best way. Of course we are then sure that, out of that condition of loading, the bridge will be in its normal condition. Of course we assume a certain camber, but this method is followed by certain bridge companies.

Another method is that we consider the truss or the chord that carries the floor under the full load as horizontal, and then the members are figured for the maximum loads they are intended to carry. Now we well know that maximum stresses in the different members occur under different loadings. For instance, the chord members receive the maximum stress for full loading of the bridge, while the web members only receive the maximum strains with partial loading. I think this last method is wrong.

EMIL SWENSSEN: The last method is probably the best if the computer will take the uniform load on the structure and find the different strains in different members as the result of that uniform loading, instead of taking the maximum load—which has been the method pursued in some large spans lately erected.

The Chenoweth System of Jointless Sewers, Drains, Electrical Conduits, Etc.

A novel system of making sewers, drains and conduits without joints has been devised by Mr. A. C. CHENOWETH, C. E., and is thus described as first used in a telephone wire conduit for the Croton Aqueduct Department at Yonkers, N. Y.

This conduit was 4 ins. in diameter inside and was made of concrete in place. The peculiar feature of the device is the manner of forming the core or center for molding the conduit. The first thing in this operation was to wind upon a collapsible wooden mandrel (made in two halves and driven apart by wedges), a galvanized iron ribbon of the uniform width of 1 in. and No. 27 wire gage in thickness. One end of this ribbon was tacked to the mandrel, which latter was then revolved and the ribbon wound spirally upon it for a length of about 6 ft.

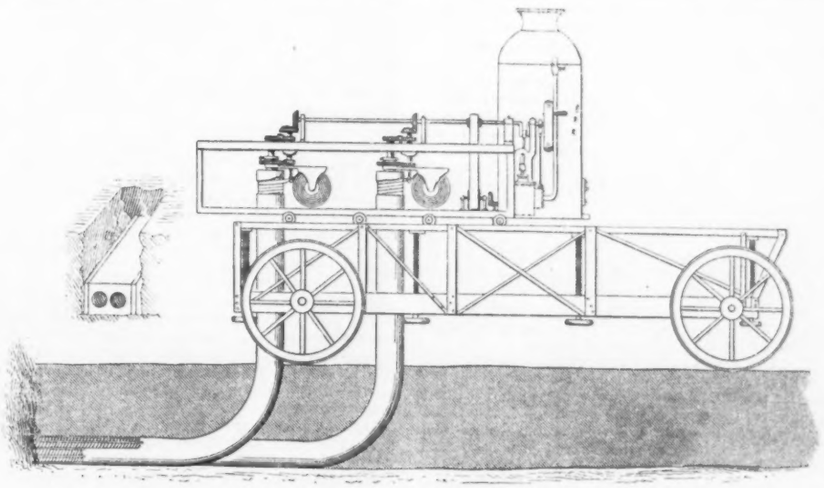
The trench was next excavated and a bed of plastic concrete was prepared and on this was laid and imbedded the ribbon wound core, which latter was then covered with the required thickness of plastic concrete and this again with broken stone and earth. By withdrawing the wedges the two halves of the wooden mandrel were withdrawn and the spirally wound ribbon was left as a center. Another length of mandrel with its ribbon was now laid in contact with the first section and the ends of the galvanized iron ribbons were joined with rivets. The second section was now made and the wooden mandrel removed as before, and in a similar manner the conduit was continued to the desired length. The ribbon is always united to the succeeding one by rivets, so that in the final work it is in one continuous piece.

Ten days after the laying of the concrete conduit and after the street surface had been completely restored, the spiral ribbon was withdrawn through manholes, leaving the concrete conduit smooth and absolutely without joints. The withdrawal of this thin ribbon was accomplished with ease and it was wound up ready for a similar use. This conduit has been used for some months and is said to be in excellent condition throughout.

Another test has been made in a sewer at High Bridge, N. Y. This sewer was 12 in. in diameter and circular, and was laid for a distance of 200 ft. on a slope of from 45° to 60° from the horizontal. In this case the galvanized iron ribbon was 6 in. wide and of No. 27 gage. It was wound as before on a collapsible mandrel, covered with concrete and was finally easily removed. The inventor believes that several hundred feet of ribbon of this kind can be taken out without trouble.

Mr. CHENOWETH has also devised a machine for winding a ribbon of heavier gage from a bobbin about a mandrel revolving in the opposite direction, which then pushes off this spiral and through a trailing tube delivers it at the bottom of a prepared ditch, ready to be covered with concrete and without the wooden core. This machine is shown in our illustration. By using ribbon properly gored or of varying widths, curves are turned, and almost any opening of circular section can be formed. The inventor enumerates among its advantages—simplicity, avoidance of joints, durability and stability, facility of repair and modification of form, sanitary advantages, negative qualities of concrete in contact with electricity or gases, convenience of production, speed in construction, and, finally, economy in cost. The patents covering this device are now the property of the Monolithic Drain & Conduit Co., No. 5 Beekman Street, New York.

While the inventor does not mention it, this device can be seemingly readily applied to the making of egg-shaped concrete sewers or drains of small dimensions, with decided advantage in cases of varying flow.



MACHINE FOR LAYING CENTERING FOR TWO CONDUITS.

North Sea and Baltic Canal.

United States Consul CHARLES F. JOHNSON, of Hamburg, reports as follows upon this important work: Since the sixteenth century sixteen plans for the connection of the North Sea with the Baltic have become known, nine of which belong to the period from 1863 to 1881. The two last projects of LEUTZE and DAHLSTROM served as a basis or guide for the project now being executed. In 1886 two laws were passed whereby the building of this canal became a certainty, and on June 3, 1887, in the presence of the late Emperor WILLIAM I., the first spadeful of earth inaugurating this great work was turned at Holtenau, near Kiel.

The canal consists of a cut 98.6 km. in length, beginning at Holtenau, on the Bay of Kiel, and terminating near Brunsbüttel, on the River Elbe, thus running clear through the province of Schleswig-Holstein from northeast to southwest. As the mean water level of the North Sea is considerably higher than that of the Baltic, both openings will be provided with huge locks. Near Rendsburg there will be a third lock connecting the new canal with the old Eider Canal.

Of the four railroads which cross the canal, three will be conducted over it by turn bridges of 36 m. clear width of trajection; one, the West Holstein Railroad, by means of a suspension bridge (near Grünthal) of 156.5 m. span. The latter, at the same time serving as a high road, is to have a height of 42 m., thus permitting the largest vessel to pass under it without lowering topmasts. The turn bridges are all constructed with one track only, in such a manner as to give a separate bridge to the double-track railroads for each of their tracks. This makes it possible in case of one of the turning benches getting out of order to conduct the traffic in both directions for a time over the remaining bridge. For the conducting over the canal of two much-frequented country roads the erection of turn bridges of equal width of trajection is contemplated. For all remaining roads of any importance ferries are to be provided, the total number of which will amount to sixteen, situated at a distance of about 6 km. from one another. There will be altogether six turnouts, to enable vessels to pass each other. They will be 450 m. long and 60 m. wide at the canal bottom.

The medium water level of the canal will be about equal to the medium level of the Kiel harbor. Considerable variations occur—on an average on about 25 days in the year only—so that the locks at the outlet on the Baltic will nearly always be open. For 60 km. from the mouth at Holtenau to the city of Rendsburg the bottom is horizontal; from here to the mouth, near Brunsbüttel, a slight declination sets in, amounting at the beginning for 20 km. to 1 in 200,000; 15 km. further, to 1 in 50,000; 12 km. further, to 1 in 33,333; and, finally, at the mouth for 12 km. to 1 in 25,000.

At the lowest tide the profile of the canal has, in a depth of 6.17 m. below the surface of the water, a navigable width of 36 m., so as to allow the largest Baltic steamers, which, with a few exceptions, do not exceed a draft of over 5 m. and a width of 12 m. to pass each other. For the conducting or drawing of the lines the movement and motion of men-of-war and of the largest vessels of the merchant marine have been determinative, because these can only pass curves having a large radius; therefore, 1,000 m. have been fixed upon as the smallest radius. Considerable expansions of the profile take place up to a radius of 2,500 m. Between two counter curves a straight line has been interpolated for the safety of the navigation of the vessels, for which a speed of 5.3 knots is admissible. Turn bridges are only built over straight lines of the canal, to facilitate observation. Sixty-two kilometres, or about 63% of the entire canal, consist of straight lines; 5 km. with a radius of 6,000 m., 5½ km. with a radius of 5,000 m., 13 km. with a radius of 3,000 m., 4 km. with a radius of 2,500 m., 1 km. with a radius of 2,000 m., 2 km. with a radius of 1,700 m., 8 km. with a radius of 1,500 m., and 3 km. with a radius of 1,000 m.

The line from Holtenau to Rendsburg runs through a very undulating country and has the greatest number of curves. The smallest curves of 1,000 m. radius are situated behind the emptying of the canal into the Firth of Kiel.

In front of the outlet into the River Elbe there is a

roadstead 8 km. in length and 1.5 km. wide, thus having a surface of 12 sq. km. Its average depth is 11 m. at lowest tide. The cutting through of 15 km. of the watershed of the rivers Elbe and Eider requires an excavation of 30 m., greatest depth to the bottom of the canal.

On the line from Rendsburg to the Baltic a ridge of hills 24 km. long and 14 to 32 m. above the canal bottom must be cut through. Just beyond Rendsburg the canal line passes through the upper Eider lakes, which will have to be lowered 2.33 m.

The flow of the canal is toward the Elbe. At high tide in the Elbe it discharges into the Baltic. At the Elbe mouth the permissible speed of flow is up to 2.8 knots; toward Rendsburg it is less. In every tide 3,000,000 to 4,000,000 cu. m., partly afflux from interior sources and the remainder from the Baltic, are moved. At the Elbe mouth the locks remain open down to 0.5 m. below the general low tide of the Elbe; on the Baltic, 0.5 m. above or below the mean water level of the Baltic.

At the lowest tide the transverse section of the canal is equal to six times the immersed transverse section of the largest merchant vessels of 60 to 62 sq. m. transverse surface. For the navy there are required 22 m. width of canal bottom, at least 58 m. width of water surface and 8½ m. depth of water. The possible deepening of 9 m. has been foreseen. The greatest depth for merchant vessels is calculated at 6.5 m. In the height of the keel of such merchant vessels drawing 6.5 m. the transverse section of the canal must be of sufficient width to permit vessels of 12 m. width to pass each other. On the banks there must remain a height of 2 m. at mean water level for the passing wave. In the height of the movement of the waves the banks are provided with stone packing. The canal bed is 22 m. wide generally; in curves under 2,500 m. radius the width is increased. Where the radius is 1,000 m. the increase amounts to 16 m. The slopes have an inclination of 1 to 3 up to 3 m. above the bed; 1 to 7 up to 7 m. above the bed. Here the slope is broken by a level 2½ to 9½ m. wide. From 7 m. above the bed the inclination of the slope is 1 to 1½, and is provided with stone packing up to 1 m. above the mean water level. The transverse section, with 8.5 m. depth of water, is equal to 380 sq. m. contents.

Altogether 78,000,000 cu. m. of earth have to be moved, to accomplish which the following is required: 27 dry dredgers, 24 floating dredgers, 97 locomotives, 100 km. of track, 2,700 dirt cars, 4 elevators, 15 steamboats, 51 receptacles for dredging utensils, 37 steam pumps, a number of forging establishments and 2 brickyards; total value, 14,000,000 marks. Up to beginning of April, 1890, 11,000,000 cu. m. had been moved, or 1,000,000 cu. m. per month. If the work is continued at this rate, there is reason to believe that the canal will be finished by April 1, 1895. Its total cost is fixed at 156,000,000 marks, or about $37,128,000. Of this amount the Russian Government paid 50,000,000 marks before work was begun. The remaining 106,000,000 marks are paid, as they are required, by the German Empire. Like all large undertakings of this kind, however, the cost will most likely reach a higher figure.

About 7,000 workmen are employed in the construction, all of whom are provided with board and lodging by the Imperial Canal Commission, under whose guidance and management the canal is being constructed. There are 38 camps for 160 to 500 men each; each camp has its own executive office, sleeping barracks and outhouses. The sleeping barracks contain heatable cells with 8 bunks each and an air space of 12 cu. m. In the executive office building there is a store for the sale of provisions and woolen wearing apparel, tobacco, etc., a kitchen and storeroom, a meeting hall of 180 sq. m., a washhouse and disinfectory and an apartment for a district surgeon. The common laborers receive about 70 cents a day, while the foremen and skilled laborers get from 95 cents to $1.15 per day. They are said to be well satisfied with their quarters and their food.

The regulations for the working of the North Sea-Baltic Canal have been adapted to the traffic to be anticipated. The traffic between the Baltic and the North Sea, including vessels coming from a greater distance, embraced, on an average, from 1871 to 1880, through the sound, 35,246 vessels; through the belts, 4,000 vessels; through the Eider Canal, 2,258 vessels; total, 41,504 vessels. The traffic in the sound was, withal, on the increase up to the year 1882. It amounted to 24,541 vessels in 1858 and 38,788 vessels in 1882. The average tonnage was 200 registered tons for sailing vessels and 620 registered tons for steamships. The average tonnage compared as follows: Sailing vessels to steamships as 1 to 3.1. On an average, 12,241,890 registered tons were moved between the North Sea and Baltic half of this freight being carried by sailing vessels, the other half by steamships. Of these craft there frequented, on the average, the German Baltic ports 9,577 vessels with 2,464,544 registered tons; Danish Baltic ports, 5,177 vessels with 1,133,895 registered tons; Swedish Baltic ports, 13,718 vessels with 4,031,821 registered tons; Russian Baltic ports, 12,084 vessels with 4,611,570 registered tons; so that Russia showed the most extensive foreign traffic, with Sweden next and Germany third. From this traffic such cargoes as can be forwarded more advantageously around the Skaugh must be deducted, and then there would remain some 9,000,000 registered tons which would come into question for the North Sea-Baltic Canal.

Considering the proportion of the tonnage of sailing vessels to steamers (1 to 3.1), and the fact that in the years 1878 to 1880 the number of steamers compared with that of the sailing vessels as 28,814 to 79,887, and that about 20 per cent. of the former and 25 per cent. of the latter sail in ballast, the annual traffic coming into question is calculated as follows:

Description.	Vessels.	Cargo.
Steamers:	Number.	Reg. tons.
In ballast	1,568	972,408
Loaded	6,274	3,888,632
Total	7,842	4,861,040
Sailing vessels:		
In ballast	5,436	1,087,050
Loaded	16,305	3,261,150
Total	21,741	4,348,200

Of this traffic, considering all the circumstances (some of the vessels are still going to take the route around the Skaugh, on the other hand the traffic increases every year), four fifths of the traffic may be counted upon for the canal for the near future. This traffic will be unequally distributed among the different months and days, and likewise unequally concerning the direction in which the canal is passed. With sailing vessels this will depend upon the wind. All of these considerations lead to the result that 27 steamers and 30 tows of 3 to 4 sailing vessels each, moving in one direction, must be regarded as the highest limit for one day; that the technical arrangements must suffice for this; but that in the future the number of steamships will increase and that of sailing vessels decrease.

The profit derived from ships using the canal instead of the route around the Skaugh is thus calculated for each minute of actual time: for steamships of 620 registered tons, 0.626 mark; for sailing vessels of 200 registered tons, 0.058 mark; so that, with regard to a passage through the canal, the value of time to steamers compares to that of sailing vessels as 10.8 to 1. The time saved by a steamship sailing from Kiel to Hamburg via the canal, instead of through the Skaugh, is estimated at 2½ days. The time of passage through the canal including stoppages and delays will be about 13 hours. By the aid of electric light traffic may be carried on at night similar to the manner in which it is at present conducted in the Suez Canal.

The fees for the use of this new waterway have not yet been fixed and will probably not be until after its completion. In times of peace the canal is to be open to men-of-war, as well as merchant vessels of every nation, while in case of a war its sole use would be reserved for the vessels of the German navy.

From the year 1858 to 1885 not less than 6,316 steamships and sailing vessels were wrecked on the Danish and Swedish coasts, and of these 91 steamships and 2,742 sailing vessels were lost. During the years 1877 to 1881 708 persons lost their lives in parts which, after the completion of the North Sea-Baltic Canal, need no longer be navigated. The loss to German shipping alone amounted to 6,150,000 marks.

Germany has two naval ports, one at Kiel, on the Baltic, and the other at Wilhelmshafen, on the North Sea, which, after the canal is finished, will be within easy access of each other. Now it would take a squadron about three days to sail from Kiel to Wilhelmshafen. Thus the North Sea-Baltic Canal, aside from its being a wonderful feat of engineering and the fact of its employing some 7,000 men for over seven years, will prove to be strategetically and commercially one of the events of the century and a safeguard against enormous losses of life and property.

In ENGINEERING NEWS, Aug. 1, 1891, will be found an illustrated description of some of the structural features of this canal.

Swing Span of the Winona Bridge.

(WITH INSET.)

We illustrate on our inset sheet this week details of the trusses and the turning and lifting machinery of the swing span of the railway bridge recently completed across the Mississippi River at Winona, Minn. This structure was built by the Winona Bridge Railway Co., in the interest of the Green Bay, Winona & St. Paul R. R. Co., the Chicago, Burlington & Northern R. R. Co., and the Winona & Southwestern Ry. Co., and is located near the east end of the city. The bridge proper is 1,260 ft. long, and consists of a 440-ft. swing-span, one 360-ft. fixed span, and two 240-ft. fixed spans. The swing span is located over the channel of the river, which is near the west shore, and the fixed spans are at the east of the swing span in the order named. At the west end the bridge is connected with the Chicago, Burlington & Northern RR. by a 300-ft. trestle approach and an earth embankment, and at the east end a similar embankment and a trestle approach, 1,200 ft. long, connects it with the Green Bay, Winona & St. Paul, and the Chicago, Burlington & Northern railways. The construction of the bridge was begun in August, 1890, and it was opened for traffic on July 14, 1891, although some of the minor details had not been completed. It was built by the Union Bridge Co., of Athens, Pa., from designs made to the standards of GEO. S. MORISON, the Consulting Engineer. The work on the ground was in charge of D. M. WHEELER, Chief Engineer of the Winona & Southwestern Ry. It is to these two gentlemen that we are indebted for the matter presented on our inset sheet.

The substructure consists of a small rectangular pier at the west end of the swing span, 6 ft. × 26 ft., under coping, with sides battered, 1 in 24; a pivot pier, 30 ft. in diameter, with vertical sides; and four ordinary piers, 22 ft. long between shoulders and 8 ft. wide, measured under the coping, with sides battered 1 in 24, and upstream end sloped 1 in 2 to form an ice breaker. All piers are supported upon piles with timber grillages. The piles are of oak, and were driven with a steam hammer, and the grillages are of pine timber, 2 ft. under water, and vary in thickness from 2 ft. to 6 ft., according to the location of the pier and the contour of the river bottom. The stone used in the piers was a limestone, procured at a quarry near Winona.

The superstructure consists of four spans, as stated above. The two 240-ft. spans are 17 ft. between centers of trusses, and are divided into eight panels of 30 ft. each. The 360-ft. span is 20 ft. between centers of trusses and is divided into twelve panels of 30 ft. each. The dimensions of the swing span are shown on the drawing. In general the compression members are of iron and the tension members of steel, soft steel being used in place of iron in the upper chord of the 360 ft. span. The center panel and a portion of the bottom chord of the swing span are of medium steel. According to the specifications all steel was to be made by the open hearth process and must not average more than $\frac{5}{100}$ of 1%, and never exceed $\frac{6}{100}$ of 1% of phosphorus. The laboratory tests were to meet the following requirements:

	Medium steel; lbs. per sq. in.	Soft steel; lbs. per sq. in.
Maximum ultimate strength	72,000	63,000
Minimum " "	64,000	55,000
" elastic limit	37,000	30,000
" elongation in 8 ins.	22%	28%
" reduction at fracture.	44%	50%

All wrought iron was required to show an elastic limit of at least 24,000 lbs., and an ultimate strength of at least 47,000 lbs. per sq. in.; an elongation of at least 10% in 8 ins., before breaking, and a reduction of area of at least 15% at the point of fracture.

The various details of the swing span are shown quite completely in the illustrations. As will be seen, it is supported by a steel drum 28 ft. 3½ ins. in diameter and 7 ft. 1⅛ ins. high, revolving upon 50 cast steel rollers. To the outside of the drum is attached a 6-in. steel shaft, carrying a pinion which engages with a rack outside of the drum and serves to turn the swing span. The power is supplied by a steam engine placed at one side of the track and just over the drum. The end lifts are operated by a shaft running lengthwise of the bridge from the center to each end, and gearing with a vertical spur wheel, which transmits the power by means of a second spur wheel to a shaft carrying a beveled gear which gears with a right and left screw moving the arms and pedestals. The dimensions of the different parts of this mechanism are given in the drawings.

The Comparative Merits of Various Systems of Car Lighting.

XI.

ADDITIONAL NOTES ON OIL LAMPS.

(*Continued from page 327.*)

A point in connection with oil lamps, not brought out in our article in the last issue, was the type of lamp required for use where an unusual amount of strong drafts is encountered. We are informed that in such places the ordinary duplex burner gives better satisfaction than any form of central draft burner. For lamps in this situation, moreover, special arrangements for air supply are generally made. The lamp supports are hollow with openings near the roof of the car, and the burner is so inclosed that air must pass down these tubular supports to reach it. Thus the points of entrance and of exit for the air used by the lamp are close together, and a reverse

draft cannot be set up in the lamp chimney. Of course the friction of the air in passing through these long passages somewhat retards the draft of the lamp chimney; and a longer chimney is needed than with the lamp with open burners.

Since the publication of our last issue we have received the following correspondence from two of the manufacturers of oil lamps referred to last week :

DAYTON, O., Oct , 7, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your article on oil lamps for lighting, you have indirectly represented that our lamp was an imitation or copy of the lamp made by the Adams & Westlake Co., of Chicago, that is to say, a person reading your article would suppose such to be the case; and as facts are quite the contrary, in justice to the company you should be made more familiar with the origin of the burner.

The writer himself is the inventor of the burner, having gotten it up in 1877 or 1878, and it has been in constant use and has been manufactured since that time by Post & Co., of Cincinnati, and can be seen in their catalogue published after that date. The Adams & Westlake Co. simply changed the manner of raising the wicks to avoid the patent, substituting for the wick raising device of the original burner the old rack and pinion movement; otherwise the burner is practically as originally made. Inclosed please find illustration of original burner taken from Post & Co.'s catalogue for 1884.

J. KIRBY, JR., Gen. Manager Dayton Mfg. Co.

CHICAGO, ILL., Oct. 9, 1891.

TO THE EDITOR OF ENGINEERING NEWS :

SIR: The paper on oil lamps for car illuminating in your issue of Oct. 10 is interesting and in the main satisfactory, but there are a few statements which are not strictly in accordance with the facts.

We are the pioneers in the introduction of the large oil burner for car illuminating, or rather the first ones to offer a large burner that would work satisfactorily. Some years ago a large Argand burner was introduced for railway service by a manufacturer, but the results obtained were so unsatisfactory that the burner was soon abandoned.

We took up the question of large burners a few years ago, spending some six or eight months experimenting before we placed our "Acme" burner upon the market. Since the success of this burner it has been copied by most of the other lamp makers.

In this connection we beg to call your attention to the statement made in your article that "if pains is not taken to guard against it, the central-draft burners may overheat the oil reservoir." The result of actual thermometric test with one of our standard "Acme" lamps shows that after the lamp had been burning continuously for hours in a closed room, free from drafts which would tend to cool the reservoir, the difference in temperature between the atmosphere of the room and the oil in fount was only 10° Fahr., and that the oil reservoir when removed from the fount was not perceptibly warmer to the touch than the surrounding air, and this too without any shade on the lamp to intercept radiation from the burner to the fount. When it is considered that with a car heated to the extreme temperature of 80° the oil in fount would be only 90°, and that the flash test of the oil used is 300°, it will be seen that there is not the remotest danger of overheating the oil. While the whitening of the glass chimney to which you refer may be a weak point in some center draft burners, and was encountered in our original experiments out of which the "Acme" burner was evolved, it is one which we have successfully overcome.

The candle power of the "Acme" lamp given in Mr. GIBBS' paper is away below that shown in many photometrical tests we have made in our shops. We have never laid much stress on the candle power of our lamps *in cents per hour*, as we know from long experience that our railway friends care less about this than about the *intensity of light per burner*. This may seem a somewhat peculiar view of the matter, but when followed up to a conclusion it proves to be grounded on good economy. Supposing, as a basis of comparison, that the "Acme" burner required just as much oil per *candle power* of light produced as the "Moehring," or "Duplex," yet the fact remains that each "Acme" will give out *twice* as much light as one of the others and therefore *three* "Acme" chandeliers will light a car quite as well as *six* of the others. As the items of labor and breakage constitute the chief expense in the maintenance of the lighting system, that burner which necessitates the least number of lamps to a car must clearly be the most economical. Consequently, even upon the showing of Mr. GIBBS, the "Acme" burner requires one half the outlay for lamps in reckoning original equipment, half the labor necessary to care for them and half the number of possible breakages as compared with the "Moehring" and "Duplex."

We should say with the flame of the "Acme" burner at the height used in a railway car, the average candle power would be between 40 and 50; therefore, with a large, ly increased candle power and but a small increase in the consumption of oil, it is obvious that the "Acme" burner is an advance in the right direction.

In the figures quoted in your table you give the cost of oil per candle power per hour for the "Acme" burner at $.00116. From actual test, a gallon of 300° mineral oil would supply one "Acme" burner for a period of 24 hours, and taking the light at a very conservative figure, say 40 c. p., the cost of candle power per hour, with oil at 9.2 cts. per gal., would be $.00095, or the same as Major HEAP obtained from the "Belgian" burner.

We were the first to introduce the glass drip cup to which you refer, and we agree with you heartily in its advantages over the old style metallic cup.

The use of the cylindrical wick raiser referred to as one of the characteristic features of the "Belgian" burner is not new, and is used on our "Acme" burner. Our wick raiser is an open shell made of perforated metal, thus allowing free access of the oil to the inclosed wick, and at the same time disposing of the rack, for the reason that the teeth of the adjusting pinion engage directly with the perforations of the wick raiser. One advantage of this method is that the wick may be put in the burner at random without turning any particular side toward the burner, as the perforations practically form a continuous rack all around the wick tube. Furthermore, in raising or lowering the wick it is not possible for one side to be raised higher than the other, the wick moving as an entirety.

The flame of the "Acme" burner is remarkably insensible to varying air currents, and in connection with our patented smoke bell and improved roof jack gives a steady, reliable light and admirable ventilation.

THE ADAMS & WESTLAKE CO.

Wages of English Railway Employees.

The London *Railway News* has compiled from a report a table of the wages of employees of the Great Eastern Ry. Signalmen, passenger and freight conductors work six days a week; passenger porters seven days a week, with one day allowed off in alternate weeks; for engine drivers and firemen 10 hours is a day's work. It will be seen that wages are very much lower in England than in this country, in fact, less than half in most cases.

Signalmen—			
At Liverpool St. and other important stations in and near London		$7.00 to	$9.00
In London and district, except as above		5.00 "	7.00
At country stations		4.25 "	6.00
Passenger porters—			
Foremen	London and district	4.75 "	6.25
	Country	4.25 "	6.00
Porters	London	3.75 "	4.50
	Country	3.50 "	4.00
Passenger conductors—			
Main line	London	6.25 "	7.50
	Country	5.75 "	7.25
Suburban	Head	6.25 "	6.75
	Under	5.25 "	5.75
Country branch	Guards	5.75 "	6.25
Freight conductors—			
London	Head	6.75 "	7.50
	Under	5.50 "	6.25
Country	Head	6.25 "	7.00
	Under	5.25 "	6.00
Local	London	6.25 "	6.75
Enginemen—		Rate per day.	
Drivers	London district	$1.32 to	$1.80
	Other districts	1.32 "	1.68
Firemen	London district	84 "	1.10
	Other districts	72 "	1.00
	Cert'd all districts	....	1.15

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Maine Central.—It is stated that this company will extend the Knox & Lincoln R. R. to either Boothbay or Camden, Me.

Little Falls & Dolgeville.—The contract for building this railway from Little Falls to Dolgeville, N. Y., 10½ miles, has been let to Godeffroy & Howe, of 45 Broadway, New York City. The work will be quite heavy, there being a large amount of bridging and rock work. The address of the contractors will be Little Falls, N. Y.

Philadelphia, Wilmington & Baltimore.—This company has commenced the survey of a line from Greensboro to Federalsburg, Md., 20 miles. It is thought that a favorable line can be secured and that the road will be built.

Pennsylvania.—The extension of the Turtle Creek Branch from Stewart's to Murrysville, Pa., 7 miles, has been completed and is now open for freight traffic.—Surveys will probably be made for a branch from Chadel's Ford, Pa., north to Westtown Station on the West Chester & Philadelphia R. R.

Iron Range & Huron Bay.—It is stated that this proposed railway from Champion to Huron Bay, Mich., about 50 miles, is now about ready for the rails and will be opened for traffic early next season. The contract for rails and equipment has not been let.

Camden, Watertown & Northern.—It is stated that contractors are now preparing bids for building this railway from Camden to Watertown, N. Y., 64 miles. It is not probable that any work will be done, however.

Rockaway Valley.—About $27,000 of the $40,000 required to build the extension of this road to Morristown, N. J., has been secured. The right of way has also been obtained and it is expected that work will begin soon. The extension will be eight miles long.

Dutchess County.—A construction train has been put at work on this railway at Hopewell, N. Y., and work is being rapidly pushed. It is expected to have the rails laid to Manchester by Oct. 25. Sixty-two car loads of steel rails are on hand.

Projects and Surveys.

Danbury & Katonah.—A company has been organized at Danbury, Ct., to build a railway via Ridgefield to Katonah, on the New York & Harlem R. R., where connection will be made with special trains for New York. The officers are SAMUEL C. HOLLY, President; DANIEL MEEKER, Vice-President; EDWARD M. BARNUM, Secretary, and ALFRED WILDMAN, Treasurer. It is said that residents of Danbury have subscribed capital to the amount of $600,000.

Odessa & Middletown.—Work is expected to commence on this short Pennsylvania railway in a few days.

Grand Rapids Belt Line.—The charter for this company has been filed with the Secretary of State of Michigan. It proposes to build a belt line of railway at Grand Rapids, Mich.

Bangor and Aroostook.—At a recent meeting of the directors the engineers' reports showed that very good progress was being made on the surveys of this road. Two lines are under consideration between Bangor and Houlton, one by the way of Mattawamkeag and the other by the way of Brownsville. Both lines are 137 miles long.

Maine Shore Line.—The engineers of this company have completed the location of the branch from Eastport to Calais, Me., 27½ miles.

Syracuse & Oneida Lake.—Chartered in New York to build a railway from De Witt to Oneida Lake, 12 miles. Among the incorporators are Nelson L. Williams, L. A. Williams and Geo. B. Warne, all of Syracuse, N. Y.

Washington & Chesapeake Beach.—This company has opened books for the subscription of its capital stock at Laurel, Md., and Washington, D. C.

Buffalo & Susquehanna.—This company has filed its charter with the Secretary of State of Pennsylvania to build a railway from Galeton, Potter Co., to Cherry Springs, in the same county, a distance of 12 miles. F. H. Goodyear, of Austin, Pa., is President, and E. O. Cherry of Austin, Pa., is Treasurer.

SOUTHERN.—Existing Roads.

Ohio Valley.—Surveys are now being made for an extension of this railway from Hopkinsville to Nashville, Ky. Between Princeton and Hopkinsville, Ky., 30 miles, grading is now in progress. The total length of the extension from Princeton to Nashville, Ky., will be 90 miles.

Paducah, Tennessee & Alabama.—Work on the extension from Paris to Hollow Creek, Tenn., is making good progress. About 18 miles have been graded, ready for the ties, and tracklaying will begin at once.

Macon & Atlantic.—It is announced that arrangements have been made for paying the debts of this company, and that work will soon be resumed on its proposed line from Macon, Ga., to the Atlantic coast. Work will be resumed at Brewton, Ga., from which point track has been laid 14 miles east, and it is expected that about 1 mile of track can be laid per day. This would complete the road by Dec. 15.

Savannah, Americus & Montgomery.—A correspondent writes as follows:

The Georgia & Alabama Construction Co. will finish the construction work on the Montgomery extension of the Savannah, Americus & Montgomery, a distance of 95 miles, during the next 30 or 40 days.

The company contracted to do the entire work of engineering (preliminary, location and construction), excluding the preliminary survey, which had been made by the railway company, grading, bridging, trestling, clearing, tracklaying, furnishing cross-ties, right of way, and all incidental work except purchasing and paying for the rails and rolling stock; the whole work to be subject to constant criticism and approval of an inspecting engineer in the service and pay of the railway company. The bid on which the work was let at a stipulated price per mile was based on a horseback survey made by Capt. R. E. Hardaway, Chief Engineer of the Construction Co., with the aneroid barometer and pocket compass, during six days of field work. The horseback survey left the then existing preliminary so far as to be a complete departure. The bid was made with a guarantee as to charge for mileage, that it should be for at least 7.4 miles less, and was based on 3,000 cu. yds. per mile less earthwork on the actual mileage than obtained on the preliminary survey made by the railway company. The location when made secured a distance of one-half mile less than the guarantee, and 4,000 cu. yds. per mile less average earthwork than the old preliminary; and obtained a much less undulating line, with the same rate, but less length of maximum gradients; and with the same maximum degree, but less total amount of curvature, without increasing cost in other respects. As located and constructed this line is much nearer level and is shorter than any other line between Montgomery and the Chattahoochee River.

Projects and Surveys.

Washington & Middleton.—Incorporated in Georgia, Oct. 6, to build a railroad from Washington, Wilkes Co., to Middleton, Elbert Co., about 30 miles. Authorized capital $500,000; company commences business with $100,000. The principal place of business is Washington. Among the incorporators are S. H. Martin, W. H. Malloy, J. W. McCalla and E. B. Head, of Elbert Co., and F. H. Colley and M. A. Phain, of Wilkes Co.

Loque & Tallulah River.—Incorporated in Georgia, Oct. 6, to build a railway from Cornelia, in Habershaw Co., via Clarksville & Burton, to some point on the North Carolina state line, about 35 miles. Authorized capital stock, $100,000; company commences business with 10%. Among the incorporators are H. V. M. Miller, E. P. Howell, and M. C. Kiser, of Atlanta.

Chalybeate Springs.—Incorporated in Georgia Oct. 6, to build a railway from Talbotton, via Chalybeate Springs, to Woodbury, Meriwether Co., about 16 miles. Authorized capital $100,000, 10% being paid in Among the incorporators are G. B. Grant, J. G. Johnston, N. C. Campbell, H. W. Hill and J. M. Terrill, of Greenville, Meriwether Co.

East & West.—Incorporated in Georgia, Oct. 10, to build a railway from Fort Valley, via Marshallville, Macon Co., to Elko, Houston Co., about 18 miles. Authorized capital stock, $25,000. The principal place of business is to be Fort Valley and among the incorporators are C. E. Gilbert, J. H. Hodges, C. C. Duncan, J. D. Martin and A. C. Riley.

Wayne Southern.—Incorporated in Georgia, Oct. 10, to build a railway from a point between Jesup and Sand Hills, in Wayne Co., to Waynesville, in Wayne Co., about 17 miles. Authorized capital stock, $100,000. Among the incorporators are J. W. Weed, O. H. Mickle, Effingham Lawrence and Bolling Whitfield. The principal place of business will be Jesup.

Paducah & Cairo.—The old pr t of building a railway from Paducah to a point on the Ohio River opposite Cairo, Ill., a distance of about 33 miles, has been revived by capitalists interested in the Paducah, Tennessee & Illinois R. R.

Thomasville, Tallahassee & Northern.—Chief Engineer R. L. Bennett states that work will be commenced in a few weeks upon this road from Thomasville, Ga., to Tallahassee, Fla.

NORTHWEST. Existing Roads.

Duluth, Port Arthur & Western.—The Duluth Superior R. R. Co. has been chartered in Minnesota to build an extension of this railway from the International line to Duluth, Minn. The Duluth, Port Arthur & Western is now completed from Port Arthur, Ont., to a point 10 miles north of the International line, where work will stop for this season. The proposed extension will pass through a rich mineral region.

Dakota, Wyoming & Missouri River.—A correspondent writes as follows:

Surveys of above named road were begun May 1. The first division from Rapid City to Mystic, on the B. & M., 23 miles, is all let and under construction. The only eastern contractors are Claffy & Foley, 48 Dey St., New York City. The line follows the valley cañon of Rapid Creek, through rich timber and mineral lands, and will be extended to Hill City and the tin district, and also into the coal and oil regions of Wyoming. Two smelters are contemplated for Rapid City. This railroad will connect Rapid City with all the principal mining camps of the hills. A remarkably good and cheap line has been obtained considering the country. F. S. D. Broughton, Rapid City, So. Dak., Chief Engineer.

Projects and Surveys.

Electric City & Illinois.—The name of this company has been changed to the Madison, Illinois & St. Louis R. R. Co., and the objects for which the company was organized have been enlarged.

Quincy, Keokuk & Chicago.—The engineers engaged in surveying this road have reached a point several miles below Warsaw, Ill., and are now progressing at the rate of one mile per day. From Warsaw to Quincy, Ill., the road will run over the levers of the Hunt, Lima Lake & Indian Grave drainage district, which will be raised and enlarged to make a substantal roadbed. The road is to run from Quincy to Niota, Ill. It is stated construction will begin in a few days.

SOUTHWEST.—Existing Roads.

Austin & Northwestern.—The contract for the extension of this road to Llano, Tex., has been signed, and work will probebly begin soon.

Corpus Cristi & South American.—A dispatch from Corpus Cristi, Tex., states that the money necessary to secure the construction of this road has been raised by the citizens of that place. Work it is stated will be resumed soon.

Southern Pacific.—The citizens along the route have raised $47,000 in aid of the proposed line from Victoria, Tex., to the Neuces River. It is understood that this company will build the line for that amount.

Choctaw Coal & Railway Co.—The receivers of this road are making efforts to secure the construction of the proposed extension from Wister, Ind. Ter., to Little Rock, Ark. The Interoceanic R. R. Co. has been chartered in Arkansas to build the portion of the road in that state. A part of the surveys for the proposed extension have been made and work is now in progress.

New Orleans & Northwestern.—The stockholders of this company have authorized the receivers to extend its road to a connection with the Houston, Central Arkansas & Northern R. R. The company has submitted a proposition for grading the division from Rayville to Bastrop, La., to the citizens of Moorehouse Parish, in which it asks that the people grade the line ready for the rails in place of the $24,000 cash subscription which has lapsed

Projects and Surveys.

Taylor, Bryan & Trinity.—The engineers have completed the surveys for this Texas railway, and are now making estimates and getting out maps. A proposition to build the line, will be submitted to the Missouri, Kansas & Texas Ry. Co., and if this is not accepted a local company will be formed.

Interoceanic.—Chartered in Arkansas to build a railway from a point on the Mississippi River opposite Memphis, Tenn., west to Hartford, on the Indian Territory line, with a branch from a point on the main line in Perry Co. to Little Rock, Ark., a total distance of 325 miles. The line is being built in the interest of the Choctaw Coal & Ry. Co.

ROCKY MT. AND PACIFIC.—Existing Roads.

Rio Grande Southern.—In a recent interview Otto Mears, President, is reported as saying:

We now have 75 miles in operation on the north end of the line, and 25 miles on the southern end from Durango to North Mancos. Beyond North Mancos, toward Rico, we have 50 miles graded, leaving only 16 miles yet to grade to complete the grading of the entire line. This gap of 16 miles will be finished in about 60 days, and by Dec. 1 we expect to have the road finished, so that trains can run clear through to Durango. The rails are being laid every day now, and I know of no obstacles in the way of carrying the work along rapidly. It is pretty certain that before the first of the year the entire line and all its branches will be in operation. When finished, the road will have cost nearly $5,000,000. In places this road has been very difficult to build. Between Ilium and Rico, I think that beyond all question it was the most difficult piece of railroad construction ever attempted in this country, on account of the great amount of heavy stone and bridge work. At one point, where the road is going around by Ophir to Trout Lake between the high cliffs, it makes a loop, and the timbers for the bridges on the upper track had to be drawn up 100 ft. by ropes.

San Joaquin Valley.—Tracklaying on this railway from Fresno, Cal., to timber lands has been resumed. The grading has been completed for 20 miles north from Fresno.

Northern Pacific.—This company has a considerable amount of work projected for the coming year. In addition to reducing the grades and curvature on its lines in Montana, Idaho and Washington, it will do a considerable amount of new construction. It is proposed to build several cut-offs. The most important of these is the extension of the Oregon & Washington Territory R. R. from Pleasant Valley to a point on the main line of the Northern Pacific near Missoula, Mont. The other cut-offs are from Palmer to Slaughter, Wash., and from Hillhurst to Puyallup Junction.

Colorado & Northwestern.—We have received the following particulars from Mr. H. R. Holbrook, of Pueblo, Col., Chief Engineer:

The proposed road has been carefully located for a distance of 120 miles northeast from Pueblo, and is projected to extend 100 miles farther. The line runs through a prairie country, and is expected to carry a considerable coal traffic. Maximum grades eastward are 0.3%, and westward are 0.6%. The road is projected as an independent enterprise. Right of way has been partially obtained and contracts will be let as soon as capital for construction is secured. Mr. O. H. P. Baxter is President of the company.

Projects and Surveys.

Phœnix, Santa Fe & Prescott.—The contract for building a portion of this Arizona railway has been let to B. Toohy.

Burrard Inlet & New Westminster.—The President, Benj. Douglass, of New Westminster, B. C., is reported as saying that the work of construction would begin soon.

CITY TRANSIT.

Electric Railways.—***Biddeford, Me.***—The Biddeford & Saco Ry. Co. is converting its line to an electric system, and is doing the work itself.

Derry Depot, N. H.—Massachusetts parties have offered to build, equip and operate the proposed electric road from the depot to the village this fall.

Winthrop, Mass.—A franchise to build an electric railway has been granted to Mr. Washington G. Benedict President of the Boston & Revere Ry. Co. When the East Boston line is equipped with electricity it will give Revere and Winthrop residents through electric service into Boston proper. It will require the building of some 7 miles of track to complete the Boston & Revere Electric Railway system.

Brooklyn, N. Y.—It is proposed to extend the Second Ave. electric road to Bensonhurst, Bay Ridge and Fort Hamilton.

Scottdale, Pa.—The Scottdale, Everson & Broadford Street Ry. Co has been organized to build an electric railway. President, Nathan Miles, Scottdale. Capital stock $30,000.

Bucyrus, O.—The Suburban Electric Railway Co. has been organized, with a capital stock of $200,000, by W. C. Lemert, G. Donnenwrirth, C. W. Fisher and O. L. Hays.

Napa, Cal.—It is proposed to build an electric road from Napa to Calistoga next spring. It will be 28 miles long.

Sacramento, Cal.—An electric road to Perkins is projected by the Central Electric Ry. Co. President, J. H. Henry.

San Francisco, Cal.—The North Beach & Mission Ry. Co. has decided to convert the horse car line from the ferry along Folsom St. to Precita Ave. into an electric road. To do this and make other improvements $1,000,000 bonds will be issued.

Horse Railways.—***Paterson, N. J.***—The Paterson Central Ry. Co. has been organized by Wm. Pennington, F. C. Van Dyk and J. R. Lee; $32,000.

Scottdale, Pa.—The Citizens' Street Ry. Co. has been organized, with a capital stock of $50,000. President, J. D. Hill.

Chartiers, Pa.—The Chartiers Valley Street Ry. Co. has been organized, with a capital stock of $30,000. President, J. T. Woods, Pittsburg.

Americus, Ga.—The Americus Transit Co. has been organized by B. P. Hollis, J. Windsor and H. R. Johnson, to build a street railway; $40,000.

Harman, Col.—A committee of five, including the town attorney, has been appointed to obtain rapid transit facilities to Denver.

BRIDGES, TUNNELS AND CANALS.

Bridges.—***Lincoln, Neb.***—The City Council has ordered the railways to build a viaduct 52 ft. wide and 6 blocks in length to cross the railway tracks.

Boston, Mass.—City Engineer Jackson has prepared plans for a bridge to East Boston 2,600 ft. in length, with a 200-ft. draw span. The estimated cost is $2,000,000. Legislation will be required before the bridge can be constructed.

San Bernardino, Cal.—Bids for a bridge of 17 60 ft. spans across Lytle Creek will be received up to and including Nov. 2 by Geo. L. Hisom, Clerk of Board of Supervisors. Plans and specifications on file in County Clerk's office. Bids must be accompanied by plans, specifications, strain sheets and working details, and a certified check for 5% of the amount bid.

Waltham, Mass.—The Board of Aldermen have passed to a second reading the appropriation of $10,000 for a bridge over the Charles River.—The following proposals were received Oct. 10 for a plate girder bridge of five spans 50 ft., c. to c., with one roadway 26 ft. and two sidewalks 6 ft. 6 in. each. Capacity, 100 lb. per sq. ft. Pine stringers and floor. Bids include substructure: Boston Bridge Works, $9,500; Berlin Iron Bridge Co., $10,900; Vermont Construction Co., $11,200; Pittsburg Bridge Co., $11,500. The contract has been awarded to the Boston Bridge Works.

Cohasset Narrows, Mass.—The bridge proposed at this point will cost $12,000 to $25,000. The County Commissioners of Plymouth and Barnstable counties have the matter in charge.

HIGHWAYS.

Maine.—The selectmen of West Madison have laid out 3 miles of new roads.

Pennsylvania.—The Mount Pleasant & Donegal Turnpike Co. has been organized at Greensburg, Pa. President, S. P. Zimmerman. Secretary, J. D. McCaleb.

Georgia.—The House has passed the road bill drawn up by Mr. Holtzclaw, of Houston, being the first general road law providing for the maintenance of public roads by taxation ever passed by the Legislature. It places the direction of road work in the hands of the county commissioners, county judge or ordinary, whichever of these authorities is in charge of county matters. A tax of 2-10 of 1 per cent. is authorized to be levied, which, with the commutation tax, not exceeding $4 per year, shall constitute a road fund. Roads may also be worked by chain-gangs.

Michigan.—A gravel road between Allegan and the Lake Shore is projected.

Wisconsin.—The committee composed of Messrs. Friessenborg, Cunningham and Willard, to survey a road to run through Ashland County, has been accepted by the County Board. The road will start at the village of Butternut, and run to Ashland. The main road will be 60 miles in length. The different towns will be assessed as follows: Vaughn, $5,500; Knight, $5,000; Jacobs, $5,500; Morse, $7,000; Ashland, $6,500; Butternut, $5,500.

WATER-WORKS.

NEW ENGLAND.

Farmington, Me.—The people have voted, 97 to 82, to contract with the Farmington Water Co. for 34 hydrants at a yearly rental of $1,200 for 5 years. The works have not been built. The city will have the right to buy the works at the expiration of the contract.

St. Albans, Vt.—Oct. 24 the people vote on the building of a new dam and reservoir and the laying of a new supply main from the present reservoir.

Alton, N. H.—An effort to form a water company is being made.

Bethel, N. H.—Works are projected at an estimated cost of $6,000.

Great Falls, N. H.—A new system is talked of by the general public.

Penacook and Boscawen, N. H.—It is reported that the precinct has voted to build works at an estimated cost of $85,000. The supply will be by gravity from Great Pond, and there will probaly be a 2,500,000-gall. distributing reservoir about three miles from the village. Surveys and estimates have been made by Bartlett, Gay & Young, Manchester. Address C. H. Amsden.

Fairhaven, Mass.—Construction of the works so long projected seems probable. It is proposed to build a filter gallery, 1,050 ft. in length, across the valley of the Naskatucket River, and to pump to a 30 × 125-ft. stand-pipe. Estimated cost, $100,000. Engineer, M. M. Tidd, Boston.

Hanson, Mass.—Works are being considered.

Quincy, Mass.—A request for 24 additional hydrants has been made.

Saugus, Mass.—An appropriation of $16,500 has been made to extend the mains.

Stoughton, Mass.—H. C. Kimball, Town Clerk, informs us that the town has chosen a committee to confer with the company regarding the purchase of the latter's works. The committee will report next March.

Worcester, Mass.—City Engineer C. A. Allen has recommended that the Holden dam be raised 10 ft. Plans have been ordered.

MIDDLE.

Chester, N. Y.—J. B. Rider, So. Norwalk, Conn., has reported on a supply from Long Pond.

Dansville, N. Y.—The following is from E. R. Woodruff, Clerk:

The village has no works except for fire purposes. We have been talking of introducing water for domestic use, but as yet nothing has been done.

Glens Falls, N. Y.—An additional supply is being considered at special village meetings.

Mechanicsville, N. Y.—P. H. Baerman, Troy, estimates the cost of works as about $56,000. It is thought that a special election will soon be called to vote on the question.

Newburg, N. Y.—A special election will be held to vote on issuing $75,000 of bonds, of which $23,000 is desired to buy land, $15,000 to build an open ditch between Washington Lake and Silver Stream, and $40,000 to remove stumps and muck from the lake. A new 2,000,000-gall. pump is also proposed.

Newtown, N. Y.—The Board of Town Officers has voted not to give a franchise to the Newtown Water Supply Co.

New York, N. Y.—The Aqueduct Commissioners propose to modify the plans for a high masonry dam at the mouth of the Croton River to conform more nearly with the design of Chief Engineer Fteley, and to bring the cost within $1,000,000.

Walden, N. Y.—Bonds for works to the amount of $25,000 have been voted. It is stated that the supply will be pumped from the Wallkill River to a 200,000-gall. stand-pipe, and that 2½ miles of street mains will be laid. Power will be furnished by the New York Knife Co.

Walton, N. Y.—The old company will build a dam across Carr's Creek.

Waverly, N. Y.—The company will extend its system in East Waverly.

Yonkers, N. Y.—We are informed that the contract for a 20 × 122-ft. stand-pipe has been awardod to Morris, Tasker & Co., Philadelphia, for $8,917.

Asbury Park, N. J.—A franchise has been granted to the West Asbury Park Water Co. All the principal mains must be laid by Dec. 1. J. C. W. Stout is one of the incorporators.

Egg Harbor City, N. J.—A franchise will probably be granted a company. William Taylor is at the head of the enterprise.

Plainfield, N. J.—The borough of North Plainfield has contracted with the Plainfield Water Supply Co. for 75 hydrants at $1,050 per year.

Irwin, Pa.—It is reported that a survey has been made for works with a supply pumped from the Youghiogheny River to a reservoir.

Philadelphia, Pa.—A gravity supply and increased pumping and storage facilities have been recommended, as noted elsewhere.

SOUTHERN.

Waynesborough, Va.—The following is from W. N. Fishbourne:

I will build works at an estimated cost of about $7,000, pumping direct to the mains at first and to a stand-pipe later. Two water-wheels, 36 and 39-in., are wanted. A 500,000-gall. pump and about two miles of mains are proposed. Population, 2,000.

Weston, W. Va.—Works are wanted.

Wheeling, W. Va.—It is reported that $100,000 will be appropriated for new pumping machinery, and $25,000 for a new station.

Green Cove Springs, Fla.—The following information has been received:

The Mutual Water Co. proposes to let contracts in November for works estimated to cost $8,000. It is hoped that sufficient pressure can be obtained from artesian wells. Address J. F. Greed, Secretary. Population, 1,500.

Orlando, Fla.—Water-works bonds have been sold at par.

Collinsville, Ala.—Address Beavers & Marsh regarding proposed works.

Monroe, La.—It is reported that W. A. Bright has made a proposition to the mayor to build works.

Greenville, Texas.—It is thought that works will soon be built.

NORTH CENTRAL.

Toledo, O.—Bids for six 280 HP. boilers, setting same, and improvements to the pumping station will be received Nov. 10. A large number of meters are being put in.

Wyoming, O.—Works to be owned by the village are proposed at an estimated cost of $25,000. Supply, driven wells, by pumping. Hartwell, Lockland and Reading might be supplied in conjunction with Wyoming. R. D. Barney is Mayor.

Linton, Ind.—Works are talked of.

Kalamazoo, Mich.—W. R. Coats has reported on improvements.

St. Joseph, Mich.—Bonds have been voted for works.

Fairbury, Ill.—An extension of the mains is talked of.

NORTHWESTERN.

Tama, Ia.—Bids for building works are wanted until Oct. 22. There with be two duplex 500,000-gall. pumps, a 20 × 20-ft. surface well, or a driven well system, about three miles of 10 to 4-in. pipe, 34 hydrants, gates and specials. Adress C. A. Hilton, Mayor.

Duluth, Minn.—The finance committee of the council has been authorized to negotiate for the purchase of the company's works.

Lawrence, Kan.—An ordinance repealing the company's franchise has passed a second reading.

Dell Rapids, S. Dak.—Works are advocated by the *Times*.

SOUTHWESTERN.

Brookfield, Mo.—Cook wells will be used for a supply. D. Cheney is making plans for works and bids will soon be invited.

Childress, Tex.—G. H. Chipman can give information regarding proposed works.

Flatonia, Tex.—A water-works investigating committee has been appointed. A supply will be sought.

Gatesville, Tex.—J. S. Thatcher, Dallas, informs us that the company has let the contract for building works to S. S. Mazo & Co., Fort Worth. There will be a 350,000-gall. pump, 12 × 60-ft. stand-pipe and 20,000 ft. of street mains.

Longview, Tex.—Works are still under consideration.

Orange, Tex.—It is reported that a franchise has been granted.

PACIFIC.

Edison, Wash.—The proposed works are estimated to cost $3,000.

Medicine Lake, Wash.—At an informal meeting of citizens a unanimous vote for works was given. Address C. S. Cadwell or W. I. Dwyer.

Fort Jones, Cal.—It is reported that works will be built by E. Reichman, the supply to be pumped to a tank on a hill.

Santa Barbara, Cal.—An informal proposition to supply the city has been made by the Laguna Blanca Water Co., which is controlled by the Pacific Improvement Co. Estimated cost, $400,000.

ARTESIAN WELLS.

Pittsfield, Mass.—Wells are talked of in connection with the water-works.

Marion, S. C.—It is reported that $10,000 has been voted for a well. Address the mayor.

Aurora, Ill.—Bids for sinking another well will probably be asked soon by the Board of Public Works.

Fairbury, Ill.—A well in connection with the water-works is projected.

Tuscola, Ill.—Gray Bros., Chicago, have the contract for sinking a water-works well; price, $5,100.

Elgin, Tex.—Wells are to be sunk for a general water supply.

IRRIGATION.

Wyoming.—Laramie parties, it is said, will build a ditch between Big and Little Laramie Rivers which will be 30 to 40 miles long and irrigate 40,000 acres.

Bakersfield, Cal.—The main Canal of the Kern and Tulare Irrigation Districts will soon be located.

San Diego, Cal.—L. G. Mack, Secretary of the Santa Maria Land & Water Co. may be addressed regarding proposed improvements estimated to cost $150,000.

New Companies.—Colorado Irrigation & Land Co., Denver, Col., $500,000; to construct canal in Prowers Co. Porter Slough Ditch Co., Porterville, Cal., $50,000; directors, T. E. Henderson, Emil Newman and others. Cache Valley Canal Co., Ogden City, Utah; $1,000,000.

SEWERAGE AND MUNICIPAL.

Sewers.—*Massachusetts.*—Revere. A town meeting has been held for the discussion of the sewer question.—Nantucket. A survey is being made for the proposed sewer system.

New York.—Goshen. The sewer question is again being agitated.—Sandy Hill. Plans for a system of sewers, to cost $50,000, have been presented to the village authorities by Mr. P. H. Baermann, of Troy.—Olean. Mr. C. C. Hopkins, of the Stanwix Engineering Co., Rome, N. Y., has been engaged to prepare plans for the sewerage system.

New Jersey.—Orange. Proposals for the construction of the outlet sewer have been received from Smith & Minahin, of Easton, Pa.; Henry C. Eyre, of Philadelphia, Pa.; Edward McGovern, of Lancaster, Pa.: Sandford & Stillman Co., of Jersey City, N. J.; the Empire Construction Co., of New York, and Condon & Curley, of Jersey City.

Pennsylvania.—Corry. Work has been commenced on the sewer system. R. H. Wilson, of Saltsburg, Pa., is engineer, and W. J. Dunn, of Allegheny, Pa., is contractor. The estimated cost is about $70,000.

Ohio.—Cincinnati. The Board of Administration has had plans and specifications prepared for sewers and drains in District No. 24.

Michigan.—Negaunee. A sewer system is projected, at an estimated cost of $46,700.—Ann Arbor. The sewer question has been defeated by one vote, and will now be deferred until next spring.

Utah.—Ogden. New sewers will be built at a cost of $17,000.

Washington.—Seattle. The Board of Public Works has decided to readvertise for bids on the Lake Union sewer to give contractors the opportunity of bidding on lining and excavation in one bid instead of requiring separate bids on each as before.—Fair Haven. The contract for section No. 1 of the sewer system has been awarded to Boyce & McKenzie. The other sections will be readvertised.

Arizona.—Phœnix. The Arizona Water-Works & Sewerage Co. has been organized by Frank Baxter, H. N. Alexander, and J. L. B. Alexander, to build sewers under a franchise from the city. Capital stock, $500,000.

Street Work.—*Connecticut.*—Birmingham. It is proposed to pave Elizabeth St. with granite blocks, but the property owners have petitioned for vitrified brick.

Ohio.—Piqua. Brick paving is projected, and a committee has inspected this class of paving at Dayton.

Illinois.—Lincoln. An ordinance has been introduced providing for about a mile of brick sidewalks.

Minnesota.—Duluth. Lake Ave. is to be paved with cedar blocks on plank and sand foundation.—St. Paul. The Board of Public Works recently opened bids for the paving of Third St. with cedar blocks. The estimate of the City Engineer for the work was $10,200, and as the bids ran from $11,295 to $12,500 the board rejected them all, and instructed the clerk to advertise for new bids.

Washington.—Tacoma. There is considerable discussion over the paving material to be adopted. Bituminous rock is favorably considered. Brick, stone, wood and asphalt have also been discussed.

Bonds.—San Antonio, Tex.; $15,000 at 6% for paving. Hastings, Neb.; $25,000, for paving. Redlands, Cal.; $100,000, for storm water canals. Lynn, Mass.; $25,000, for sidewalks. St. Paul, Minn.; $25,000 by the Park Board, for improving Lake Como. Atlanta, Ga.; $140,000, 4½%. Dayton, O.; $100,000, for street paving; C. A. Herbig, City Auditor, Oct. 23. Orlando, Fla.; $15,000 for paving, sold to Barnes & Nokes, Los Gatos, Cal.; $25,000 for sewers and $5,000 for street. Montesano, Wash.; $100,000 county bonds; the Lewis Co. Commissioners.

ELECTRICAL.

Electric Light.—*Franklin, N. H.*—The Gas & Electric Light Co. has let a contract to the Edison Co. for a plant with 45 arc lights. The company will light Franklin Falls with 33 lights at $65 per light per year for 5 years.

Saratoga, N. Y.—The taxpayers have voted in favor of electric lighting for the streets.

Tyrone, Pa.—The Home Electric Light Co. has a 3 years' contract for 2,000 c. p. lights at $75 per light per year.

Franklin, Va.—An electric light plant is to be put in. For particulars address the Mayor.

Waynesboro, Va.—The Waynesboro Street Railway, Light & Water Co., Mr. W. N. Fishburne, President, will put in a dynamo with a capacity of 500 lights of 16 c. p., and will drive it by water power.

Cleveland, O.—A street lighting contract is expected to be made with the electric railway companies.

Tipton, Ind.—A contract for 15 Thomson-Houston lights has been let to A. S. Nickey at $70 per light per year.

Lincoln, Ill.—An ordinance has been passed which provides that the city pay $4,250 per annum for 65 arc lights of 1,200 c. p., 50 to be lighted dark nights from a few minutes after sunset until midnight, and 15 to burn all night. These lights are to be suspended from wires attached to poles 20 ft. high from the ground. If the city should require more lights the all-night ones are to cost $70 per annum and the midnight ones $60.

Rich Hill, Mo.—The town has voted in favor of electric lighting, which will be put in by W. P. Munro, of Nevada.

Ogden, Utah.—The Ogden City Ry. Co. has applied for a franchise for using its wires for electric lighting.

Seattle, Wash.—The joint street light committee, to which was referred the communication of the Board of Public Works, together with bids submitted for lighting the streets for the ensuing year, reported that the city should own and control its own street lights, but could not see how it was possible to do so at present. It therefore recommended that a proposition to bond the city for the necessary funds for that purpose be submitted to the voters at the next general election. The report was adopted.

Modesto, Cal.—The Board of City Trustees has awarded a contract for lighting the streets and jail to the electric light company, at $5.50 per light.

Companies.—Leslie Electric Light & Power Co., of Leslie, Mich.; for light, heat and power; $10,000. St. Paul Electric Mfg. & Construction Co., of St. Paul, Minn.; Paul Mattin, J. T. Hughes, C. H. Lieman; $100,000. Lander Electric Light & Power Co., of Lander, Wyo.; J. D. Woodruff, E. Amoretti and W. Wallace; $10,000. Ashuelot Valley Electric Lighting, Heating & Power Co., of Winchester, N. H.; Merchants Electric Light Co., of Leavenworth, Kan.; President, C. M. Salinger; Secretary, J. H. E. Wiegant. Heat, Light & Power Co., of Chicago, Ill.; D. E. Davis, Wm. Barrett and Ernest Kauffmann; $20,000,000. Cataract Electric Co., of Buffalo, N. Y.; C. H. Sweet, F. H. Locke, E. Hayes; $40,000.

CONTRACTING.

Sewers.—*Baltimore, Md.*—The following proposals have been received by the City Commissioner for furnishing material for the Druid Hill Ave. intercepting sewer. The sum appropriated for the sewer is $190,000. Bricks: Pitcher & Creager, hand-made, $9.25 per 1,000, machine made, $8.50; W. H. Perot, $8 for each; J. R. Busey & Son, $9.40 and $8.60; Kline Bros., hand-made, $8.49; Donnelly & Son, $8.39 and $7.99; Maryland Brick Co., machine, $7.20; George W. Robinson, Jr., & Bro., $8.40 and $8. Sewer blocks: Benjamin Kepner, $155 per 1,000, or $1.55 per yd.; McClenahan & Bro., $260, or $2 65; Guilford & Waltersville Co., $195 or $2.58. Rubble and dimension stone: John Harris, rubble, $2.10 and $15.50 per cu. yd.; J. H. Atkinson, $1.85; B. Kepner, $2.50 and $45; Maryland Granite Co., $1.75 and $7. Sand: Leonard & McGovern, 85 cts. per cu. yd.; Pat Keelty, 90 cts.; Morgan & Bresnan, 84 cts. Timber: Heise & Bruns North Carolina pine $13 per M, Virginia $12 and $13, chestnut logs 75 cts. each; J. S. Hoskins, logs $2.25 each; P. M. Womble, North Carolina $12.50 to $14.50, Virginia $11.50 to $12.50, logs 60 to 75 cts. each.

Monmouth, Ill.—The contract for sewer construction has been awarded to Peter Simons, of Burlington: 18-in. vitrified pipe, 85 cts, per ft.; 15-in., 69 cts.; 12-in., 69 cts.; 12-in., 54 cts.; 8-in. laterals, 50 cts.; 6-in. slants, 38 cts.; catch basins and connections, $32 and $8 each; manholes $30 each.

Dredging.—*Detroit, Mich.*—The following proposals have been received for dredging 4,500 cu. yds. at the light-house depot wharf: T. M. Hubbell, Detroit, 35 cts. per cu. yd.; J. C. & J. H. Davis, Toledo, O., 39 cts.; B. Norton & Co., Detroit, 41 cts. The contract was awarded to T. M. Hubbell.

Fortifications.—*Philadelphia, Pa.*—The contract for material for the construction of a pile and timber foundation for a mining casemate, cable gallery and passage way on Pea Patch Island, Delaware River, has been awarded by Major C. W. Raymond, U. S A., to Henry M. Doremus, Newark, N. J., at the following prices: 24,000 lin. ft. of Delaware pine piles, 12½cts. per lin. ft.; 11,000 ft. B. M. of yellow pine pile caps, $37.50 per M., B. M.; 12,000 ft. B. M. of yellow pine plank, $36 per M., B. M.: 750 lin. ft. of white oak trenails, 6cts. per lin. ft.; 600 lbs. cut spikes, 5cts. per lb.; 300 cu. yds. of gravel or sand, 50cts. per cu. yd.; total, $4,069.

Levees.—The contract for 40,000 cu. yds. of the Cabin Teele levee, Louisiana, has been awarded to Robt. Johnson, of Memphis, Tenn., at 17¾ cts. per cu. yd. The lowest bids for the Hardscrabble and Tensas levees have been approved by the War Department as follows: Tensas Basin in Louisiana: Kempe, upper section, Tensas parish, 98,500 cu. yds., Carey & Bradburn, 23.79 cts. per cu. yd.; lower section, 33,700 cu. yds., T. A. Helgason, 14.45 cts.; middle section, 66,000 cu. yds., Carey & Bradburn, 44.98 cts. Hardscrabble, Tensas, 104,000 cu. yds., Carey & Bradburn, 29.98 cts. The contract for the Cottage Home levee, in Tensas parish, 90,000 cu. yds., has been awarded to S. L. Jones at 12 cts. per cu. yd.; and the contract of the Deer Range levee, in Plaquemines parish, 36,000 cu. yds., to S. J. Trawley at 15.23 cts. The contract for the new levee at Fortville, La., has been awarded to the Andrews Bros. Construction Co. at 13.44 cts. per cu. yd.

PROPOSALS OPEN.

Land Reclamation.—*Toronto, Ont.*—Improving the sanitary condition of Ashbridge's Bay and reclaiming marsh lands. For particulars see advertisement. Edward Hewitt, Chairman Ashbridge's Bay Committee, City Hall. Nov. 4.

Roads.—*Pensacola, Fla.*—To oversee repairs and construction of roads and bridges of Escambia County. The Board of County Commissioners, Pensacola, Fla. Nov. 10.

Sewers.—*Roanoke, Va.*—About 2,000 ft. of brick storm water and intercepting sewer. J. J. Sheehan. Oct. 20.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Baldwin Locomotive Works, of Philadelphia, Pa., have built a ten-wheel compound engine for the New York, Lake Erie & Western; also a ten wheel compound, 2 ten-wheel simple and 2 eight-wheel simple engines for the Los Angeles terminal. They have orders for 10 compound engines for the Philadelphia & Reading, 5 for the Pennsylvania and 2 for the Lehigh Valley, and for a three-cylinder engine for the Pike's Peak rack railway. The Cooke Locomotive Works, of Paterson, N. J., have an order for 25 engines for the Chicago, St. Paul & Kansas City. The Schenectady Locomotive Works, of Schenectady, N. Y., have an order for 41 eight-wheel and 19 mogul engines for the New York Central & Hudson River. The Rhode Island Locomotive Works, of Providence, R. I., are building a double-end tank engine for the Portland & Rochester. The Canadian Locomotive & Engine Co., of Kingston, Ont., has completed one of the tank engines for the Chignecto Ship Ry.

Cars.—The St. Charles Car Co., of St. Charles, Mo., has orders for 10 passenger cars for the Lake Shore & Michigan Southern, and 2 baggage cars for the Pittsburg & Lake Erie. The Barney & Smith Mfg. Co., of Dayton, O., is building 20 passenger cars, 2 dining cars and 6 mail and express cars for the Northern Pacific. The Duluth Mfg. Co., of Duluth, Minn., has an order for 100 freight cars for the East Tennessee, Virginia & Georgia. The Mt. Vernon Car Mfg. Co., of Mt. Vernon, Ill., has orders for 200 coal cars for the Evansville & Terre Haute, 100 refrigerator cars for the Mobile & Ohio and 50 box cars for the Southern Dispatch Lumber Co. The Limestone Springs Lime Co., of Gaffney City, S. C., wants 2 standard gage second-hand street cars.

Car Heating.—The direct steam heating system of the Consolidated Car Heating Co., of Albany, N. Y., was lately adopted by the New York Central & Hudson River R. R. in place of the Martin system, the work of equipping the cars to be completed within 60 days, and the Sewall steam coupler to be used. This was the outcome of an injunction obtained by the Martin Co., preventing the use of the Sewall coupler with its system of steam heating, but that company has since withdrawn its opposition. The Canadian Pacific has recently ordered of the Consolidated Car Heating Co. 90 commingler equipments; the Boston & Maine, 65; the Old Colony, 50, and the Concord & Montreal 35. With all of these the Sewall coupler is used. The company has completed the equipment with steam heat of the last of the 200 cars for the New York, New Haven & Hartford R. R., and is rapidly applying its hot water circulating system to the cars of the New York & New England R. R., in connection with which the Gibbs coupler is used.

Car Lighting.—The limited trains of the Cincinnati Southern R. R. between Cincinnati and Florida are being fitted for the use of the Pintsch gas system, in preparation for the winter traffic.

The International Railway Equipment & Supply Co., of New York, has been organized. President, G. W. Bentley; Vice-President and General Manager, G. Leve; office, 45 Broadway.

The National Water Purifying Co., of New York, reports a second order from the Mfg. Investment Co., of Madison, Me., for a high pressure filter plant of 2,000,000 galls. capacity in 24 hours.

The C. W. Hunt Co., New York, manufacturing hoisting plant, portable railway track, etc., states that having no trade with middlemen, and paying no commissions, it gives no anxious thought as to whether parts can be made a little cheaper, but tries to have material and workmanship as good as possible.

The Berlin Iron Bridge Co., of East Berlin, Conn., has the contract for rebuilding, with iron buildings of its own design, the plant, recently destroyed by fire, of the Delaware Iron Co., owned and operated by Morris, Tasker & Co., of New Castle, Del.

Companies.—Pneumatic Standard Railway Gate & Mfg. Co., of Chicago, Ill.; E. Oates, W. O. Osgood and John Irvine; $300,000. Steele Signal Co., Chicago, Ill.; J. W. Steele, Charles Higgins and H. W. Powers; $1,000,000. Red Wing Sewer Pipe Co., of Red Wing, Minn.: President, E. H. Blodgett; Secretary, T. W. Hoyt; $100,000. Santa Maria Asphalt Co., of Santa Maria, Cal.; $250,000. Switch & Foot Guard Co., of Jersey City, N. J., to manufacture the Wakefield Foot Guard, for frogs and switches; $100,000. American Engineering Co., of Jersey City, N. J.; G. T. Woods, of Jersey City; C. C. Horner, of Brooklyn, N. Y.; Henry Rein, of New York, N. Y.; $1,000,000. Consolidated Railway Construction Co., of Jersey City, N. J.; $500,000. National Gas Heating Co., Camden, N. J., and Philadelphia, Pa.; J. J. Martin and H. C. Francis, of Philadelphia; J. E. Barton, Camden, N. J.; $1,000,000.

Metal Market Prices.—*Rails.*—New York: $30.80 to $31; old rails, $21 for iron and $16.50 to $17 for steel; girder rails, $40. Pittsburg: $30; old rails, $23.75 to $24.50 for iron and $18 to $18.50 for steel. Chicago: $30.50 to $33; light and street rails, $32.50 to $35; old rails, $21 for iron and $14 to $16 for steel.

Track Materials.—New York; steel angle bars, 1.75 to 1.9 cts.; spikes, 2.15 to 2.25 cts.; track bolts, 2.8 to 3 cts., with square and hexagon nuts. Pittsburg: splice bars, 1.75 to 1.85 cts. for iron or steel; iron or steel spikes, 2.1 to 2.15 cts.; iron track bolts, 2.7 cts. with square and 2.8 with hexagon nuts. Chicago: splice bars, 1.85 cts. for iron, 2 cts. for steel; spikes, 2.2 to 2.25 cts.; track bolts, 2.75 cts. with hexagon nuts.

Pipe.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 57½ and 47½ per cent. on black and galvanized butt-welded; 67½ and 55 per cent. on black and galvanized lap-welded. Casing, 55 per cent.

Foundry Pig Iron.—New York: $14 to $17. Pittsburg: $14.50 to $16.50. Chicago: $14.50 to $17.50.

Lead.—New York: 4.45 cts. Chicago: 4.35 to 4.4 cts. St Louis: 4.3 to 4.32 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.9 to 2.1 cts.; tees, 2.45 to 2.75 cts.; sheared iron plates, 1.95 to 2.25 cts.; steel plates, 1.95 to 2.15 cts. for tank, 2.2 to 2.3 cts. for shell, 2.45 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2 cts.; tees, 2.6 cts.; universal iron mill plates, 2 to 2.05 cts.; sheared steel bridge plates, 2.15 to 2.2 cts.; refined bars, 1.8 to 1.85 cts.; steel plates, 2.05 to 2.1 cts. for tank, 2.15 cts. for shell, 2.4 to 2.55 cts. for flange, 3.9 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.05 to 2.1 cts.; tees, 2.6 to 2.7 cts.; universal plates, 2.15 to 2.2 cts.; sheared steel plates, 2.2 to 2.25 cts. for steel; steel plates, 2.4 to 2.6 cts. for tank, 2.75 to 3 cts. for shell, 3 to 3.5 cts. for flange; 5 to 5.5 cts. for firebox; boiler rivets, 4.25 cts.

Reclamation of Marsh Lands.

Tenders addressed to the undersigned will be received through registered post up to noon on Wednesday, the 4th day of November next, for improving the sanitary condition of Ashbridge's Bay and reclaiming the marsh lands adjacent thereto.

These lands comprise about 1,300 acres, and are situated on Lake Ontario, within the limits of the city of Toronto, and will, when reclaimed, be valuable as sites for manufacturers of all kinds.

Terms, conditions and specifications for the proposed works have been adopted by the City Council. Copies can be obtained upon application at the office of the City Clerk. Plans of the works may be seen at the office of the City Engineer.

The consideration to be given by the city in payment for the works and improvements will be a lease of the strip of land along the south shore of Ashbridge's Bay, and the land now known as the "Marsh" for a term of forty-five years, free of rental, such lease to be renewable for a further term of twenty-one years, the rental to be determined by arbitration in the usual way.

ALTERNATIVE TENDERS.

Parties who do not desire to tender upon the specifications adopted by the City Council may submit alternative tenders.

The city reserves the right to reject any or all. EDWARD HEWITT,

Chairman Ashbridge's Bay Committee.

CITY HALL, TORONTO, Oct. 2, 1891. 42-2t

Proposals for Pumping Machinery

Sealed proposals will be received by the Board of Water and Lighting Commissioners, of the City of McKeesport, Pa., until noon on the 5th day of November, 1891, for the furnishing and erection of two (2) three million gallon, horizontal duplex direct acting, compound condensing, or non-compound condensing, rotative pumping engines, of the outside center packed water plunger pattern, for the McKeesport Water Works; together with all appurtenances and connections thereto, as set forth in the specifications for said engines, now in the office of the Superintendent of waterworks.

Said Board of Commissioners reserve the right to reject any or all proposals.

Copies of specifications will be mailed upon application. All proposals shall be endorsed "Proposals for Pumping Machinery" and directed to the undersigned.

By order of the Board,

JOS. ECOFF, Superintendent.

Oct. 7, 1891. 41-3t

JAMES H. FUERTES,

CIVIL ENGINEER,

CAMDEN, ARKANSAS.

Surveys, Designs for and Superintendence of Construction of Bridges, Roads, Sewers and Water Supply.

Examinations and reports on condition of existing structures.

WRECK OF SCHOONER ANDREW J. YORK—Engineer Office, U. S. Army, Newport, R. I., Oct. 2, 1891. To whom it may concern: Whereas, navigation is obstructed and endangered by the wreck of the schooner Andrew J. York lying in Nantucket Sound, about 7½ miles N. W. ¼ N. from Nantucket Light; Notice is hereby given to all persons interested in said vessel, her cargo and all other property therein, that if within thirty (30) days from the date of this advertisement they shall not have signified to me their intention and taken preliminary steps to remove said wreck, etc., as soon as practicable, the same will be considered as abandoned and derelict, and will be removed by the United States under authority of law. Sealed proposals, in triplicate, for the removal of said wreck will be received at this office until 12 o'clock, noon, on Monday, the 2d day of Nov., 1891, and then opened. The attention of bidders is invited to the Acts of Congress approved Feb. 26, 1885 and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. The United States reserves the right to reject any or all proposals, and to waive any informalities. Full information furnished on application. By authority of the Secretary of War: W. R. LIVERMORE, Major of Engineers. 41-3t

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